COMPTON'S

PICTURED ENCYCLOPEDIA

AND

FACT-INDEX

INTERESTING · ACCURATE · UP-TO-DATE

To inspire ambition, to stimulate the imagination, to provide the inquiring mind with accurate information told in an interesting style, and thus lead into broader fields of knowledge—such is the purpose of this work

VOLUME 15

F. E. COMPTON & COMPANY · CHICAGO

Here and There in This Volume

AT ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit far-away countries and watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study-guide. For these purposes consult the Fact-Index and the Reference-Outlines.

For the Reading and Picture Hour

High Lights in History's Pageant

Some Famous Men and Women

The Story of the Presidents

Tours Through America

HERE AND THERE IN THIS VOLUME

Travel-Views of Lands Across the Seas

Sports and Games

In the Plant and Animal World

Marvels of Science and Invention

The World at Work

Guide-Posts to Literature, Art, and Music

Rambles Through Factland

HERE AND THERE IN THIS VOLUME

Interest-Questions Answered in This Volume

What animals weigh at birth as much as a full-grown elephant? 80, 79 picture.
What plant depends on the moth for its survival? 211.
Why do many water-plants have long slender leaves? 48.
What birds build community nests? 62.
Are whales fish? 77.
What animal makes its home highest in the mountains? 203.
Why was the yew tree so popular in England? 206.
Why do whales "blow"? 77.
Why does the woodpecker peck? 134.
What insects are original paper makers? 32.
How do wolves hunt? 128.
What sea animals furnish ivory? 6.
How does the wasp paralyze its prey? 34.
Why are weeds the "bad boys" of the vegetable kingdom? 64.
What American state contains both the highest mountain and the lowest depression in the country? 96.
What American city is beautified each spring by Japan's national flower? 22 picture.
Which state in the Union has the nickname "Mountain" or "Panhandle State?" 74.
Why is Wisconsin called the "Badger State"? 127.
Where is the "Land of King Arthur"? 3.
What city furnished powder for all American wars since 1802? 105.
What animal gives Michigan its nickname? 130.
What is the largest national park in the United States? 205.
What explorer tried to explore the floor of the Arctic Ocean in a submarine? 98.
What fruit is a favorite in Yugoslavia? 213.
What is the earliest form of writing? 184.
What French writer emphasized the effects of heredity in his novels? 218.
Whose translation of the Bible set early standards for the English language? 191.
Where are Canada's highest mountains? 214.
What is the 'Anabasis'? 197.
How may we learn from the boyhood of Whittier? 96.
Where is the "Poet's Corner" in which England honors her great writers? 73.
What famous orator was too shy as a lad to speak a piece in school? 63.
How many bushels of wheat are required to make a barrel of flour? 81.
What is the best wood for making gunstocks? 5.
What was the first universal religion? 231.
What bird has a cylindrical tongue? 134.
What water-plant has leaves large enough and strong enough to support a child? 47 picture.
Why is the number of jewels in a watch always odd? 39.
What insect rows himself through the water upside down? 46.
Who brought windmills to Europe? 111.
Which country first granted women full suffrage? 133.
Why is James Watt famous? 56.
How can you tell whether a cloth is all wool? 140.
What Flemish city did the British Tommies call "Wipers"? 209.
What ancient civilization flourished in Yucatan? 210.
What is galvanized iron? 217.
Why are residents of the District of Columbia not allowed to vote? 28.
Why is the home of the president of the United States called "The White House"? 86.
What is the Smithsonian Institution? 26.
What was first used for runners on skates? 115.
Who was the first man to fly in an airplane? 183 picture.
In what war was the most important battle fought after peace was declared? 10.
What general's reckless bravery gave him the nickname "Mad Anthony"? 58.
What first lady was married in the White House? 92.
Which brothers came to America as missionaries and founded a religious denomination? 72.
What was "Mr. Madison's War"? 10.
Who was both wife and mother of a president of the United States? 89.
How many islands are there in the West Indies? 72.
How did Rome get its water supply? 54.
What president first lived in the White House? 86.
How did a pig and some sheep cause a dispute between Great Britain and the United States? 32.
What ruler had a shriveled arm from birth? 100.
What English king and queen were joint rulers? 103.
What great conqueror was born in the same year as the man who finally defeated him? 70.
How did the moon give us our week? 65.
How are time signals sent throughout the United States? 41.
What primitive musical instrument was named for Pan? 135.
How many years did Noah Webster work on his dictionary? 63-4.
What woman has her statue in Statuary Hall? 99.
Did the invention of the cotton gin make Eli Whitney rich? 96.
What four children slept "crosswise" on the long bed built for Abraham Lincoln? 86.
How did people tell the time in the Middle Ages? 35.
Where do we get the expression "in the doldrums"? 112.
Who started the sport of "curling"? 117.
What is meant by dying intestate? 98.

Key to Pronunciation

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index. Marked letters are sounded as in the following words: *cāpe, ăt, fär, fȧst, whạt, fa̤ll; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, do̤; cūre, bŭt, rṳde, fu̇ll, bûrn; ü* = French *u*, German *ü; ġem, ḡo; thin, ŧhen; ṅ* = French nasal (*Jeaṅ*); *zh* = French *j* (*z* in *azure*); *ᴋ* = German guttural *ch*.

WAGNER (*väg'nẽr*), WILHELM RICHARD (1813–1883). More than any musician of his time, Wagner placed his own characteristic stamp on every established form of music, though he is usually thought of especially as the man who re-created opera by giving it hitherto unknown power and beauty.

Wagner was born at Leipzig, Germany. His stepfather was a celebrated actor who did much for the boy. As a schoolboy Wagner was eccentric and independent of established customs, but he became an excellent Greek scholar. His musical ambition was fired by the works of Beethoven and Weber; and when he was but 17 his first overture was performed at a theater in Leipzig, astonishing the audience by its continuous use of the drum, even as his later music astounded the musical world by the crashing combinations of other instruments.


WAGNER
Creator of the Music Drama

For the next 12 years Wagner filled positions as chorus master in various cities. He went to Paris, hoping to produce his opera 'Rienzi', but was disappointed. However, it was most successfully produced in Dresden and resulted in Wagner's appointment as musical director of the Saxon court. Here his operas 'The Flying Dutchman' and 'Tannhäuser' were brought out, amid mingled criticism and praise; for Wagner's operas do not follow the fashion of former operas. His story is a real drama and Wagner made his music for both voice and instruments closely follow the meaning of the text. Thus his operas lacked the constant pretty melodies and pleasant harmonies of the popular opera, and while a few masters, among them Liszt and Schumann, saw in these new operas the beginning of a new art, the public found them "tedious" and "eccentric." When 'Lohengrin', Wagner's next opera, was written, long years passed before the composer himself could hear this beautiful work.

Wagner's revolutionary ideas were not confined to music. He took part in the German political revolution of 1848–49 and for this was obliged to leave the country. He found refuge in Switzerland, and remained in exile for about ten years.

In 1864 the king of Bavaria invited Wagner, who was now in very straitened circumstances, to come to Munich and continue his musical work. The 12 years of his residence there saw great progress. Here his series of operas based on the old German Nibelungenlied were composed. His operas published during and after this time are known as music-dramas, for in them he worked out his theory that a combination of all arts is necessary to produce a perfect art unit. Thus literature, music, and action have equal part, and great attention was given to scenic accessories.

But for such stupendous spectacles the opera house of Munich proved inadequate, so Wagner conceived the idea of a "festival theater" especially constructed from his own designs. The king heartily approved the project and the outcome was the famous Wagner theater in Bayreuth, a city of northern Bavaria. The first Wagnerian festival was held in this theater in 1876, and since that time almost every year has seen a series of performances attended by thousands of music lovers from all parts of the world. After his death in Venice, where he had gone for a season of rest, his body was brought to Bayreuth for burial.

Wagner's music dramas, especially those based on the old Nibelungen tales, are among his most noted productions. These include 'Das Rheingold', 'Die Walküre' (The Valkyries), 'Siegfried', and 'Götterdämmerung' (The Twilight of the Gods). 'Tristan und Isolde' is founded on a Celtic legend and is part of the King Arthur cycle, as is also 'Parsifal'. 'Die Meistersinger' is a story of Hans Sachs of Nuremberg. Wagner wrote the text of these masterpieces as well as the music, thus proving himself a man of letters as well as a musician.

After half a century of bitter controversy over his theories and innovations—especially over the startlingly novel harmonic effects he introduced—Wagner stands out as the commanding musical genius of his century. Whether "Wagnerian" or "anti-Wagnerian," no musician of the last generation has been able to escape the master's influence and write as if he had not lived, for he impressed even his antagonists.

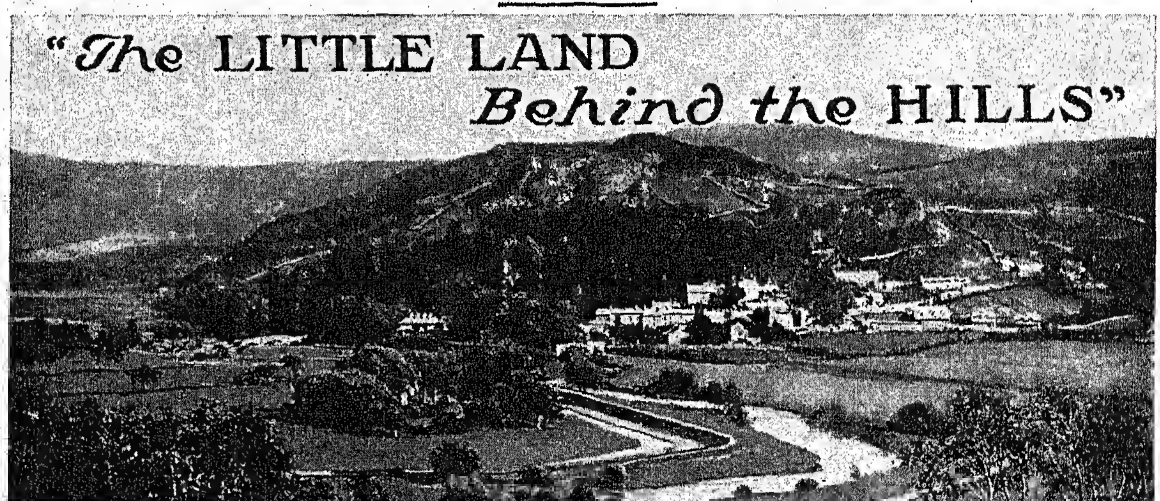
WAKE ISLAND. About 2,000 nautical miles west of Honolulu on the straight line to Manila lies the tiny American island of Wake. It is a V-shaped atoll and from the air looks like a lean thumb and forefinger pointing northwest toward Japan, 1,600 miles away. The fingertips are formed by separate islets—Peale and Wilkes—divided from the main island by narrow bands of shallow water. Around the whole circles a coral reef, blocking the open end of the V, and creating an inclosed lagoon four miles long and at the most a mile and a half wide. Nowhere is the sandy, brush-covered surface of the island more than a mile across from lagoon to ocean or more than 20 feet above the level of the sea.

At this remote outpost the Japanese struck one of their first blows in the war against the United States. They came by air Monday noon, Dec. 8, 1941 (it was Sunday, December 7, at Pearl Harbor on the other side of the international date line). On Wake Island at the time were about 1,600 people. Of these, 483 were United States marines, commanded by Maj. James P. Devereux. The rest were civilians—employees of Pan American Airways which established a station here in 1935 for its transpacific clippers, and more than a thousand Chamorro workmen from Guam who were helping to build a naval air station and supply base. An eastbound clipper, moored in the lagoon, managed to fly back to Honolulu with its passengers after the first attack.

The next 15 days added a glorious chapter to the history of the United States Marine Corps. The defenders had six 5-inch guns and 12 antiaircraft guns. Of the original 12 fighting planes, seven had been destroyed on the ground by the first rain of bombs. Thereafter the Japanese attacked by air every day except three, using from 24 to 45 bombers at a time. Marine pilots shot down at least five, and the guns brought down four. On December 11, the Japanese attempted a landing with 12 ships. Major Devereux ordered the 5-inch guns to hold their fire until the enemy had closed in to 4,700 yards. When the blast came, it sank a cruiser, two destroyers, and a gunboat. The remaining ships fled.

But, one by one, the defenders' few guns were destroyed and their planes lost. On December 23, the enemy succeeded in making a landing. Firing their last two guns, the marines disabled two destroyers. The next day the Tokyo radio announced that the surviving defenders of Wake were to be taken to Japan as prisoners of war.

Wake Island was discovered in 1796 by a passing British ship. The first landing was made in 1841 by Charles Wilkes, American explorer, and the United States took possession in 1899. But the island remained uninhabited until the Pan American Airways station was established in 1935.



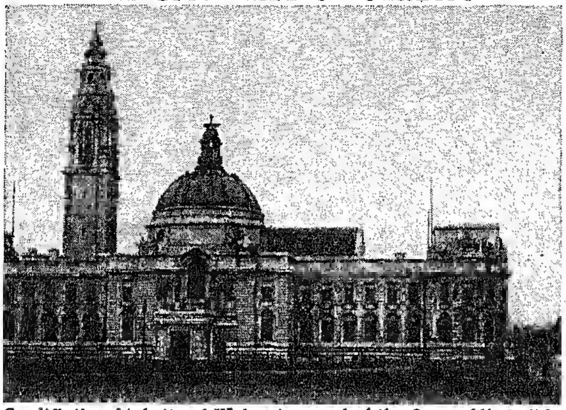
In the Picturesque Welsh Hills—The Village of Maentwrog in Merionethshire

WALES. A great modern Welshman once called Wales "the little land behind the hills." This affectionate description we owe to David Lloyd George, prime minister of Great Britain from 1916 to 1922. In fact, though, Wales is not only *behind* the hills, but all over and between the hills of the western part of Great Britain. Wales (from the Anglo-Saxon *walas*, meaning "foreign") is a great peninsula 136 miles long, north and south, by 96 miles wide at its broadest part. At the northwest corner, cut off by the narrow Menai Strait, is the island of Anglesey (276 square miles), with its port of Holyhead, from which steamers sail for Ireland. The River Dee, with England's stronghold of Chester at its mouth, comes into the north of Wales, and Bristol Channel and the Severn's mouth to the south; while Carnarvon Bay, Cardigan Bay, and Carmarthen Bay deeply indent its western shores. Snowdon (3,560 feet), the highest point in England and Wales, lies 18 miles southwest of Menai Strait. The land is one of the richest in minerals in the world, for, in addition to enormous beds of the best coal, there are deposits of iron, copper, zinc, tin, lead, and even some gold. One-fifth of all the coal of the British Isles is produced in Wales,

and Cardiff (225,000 population), on Bristol Channel, is the greatest coal-shipping port on the globe. Other cities of importance are Swansea and Merthyr Tydfil, both in the same great mining district with Cardiff. With an area of 7,466 square miles, Wales has about 2,160,000 people—nearly 300 to the square mile.

The Welsh are of Celtic stock and have a language akin to the *Erse* or *Gaelic* of Ireland and the Scottish Highlands. Like all mountain peoples the Welsh have many legends and traditions; indeed Wales may almost be called the home of British folklore and old stories. It is the land of King Arthur and his Round Table, of the "island valley of Avilion," and of Camelot. The Anglo-Saxon conquest of Britain (5th and 6th centuries A.D.) served to drive the Britons into the fastnesses of the western mountains, and the Welsh are their descendants. Beyond Snowdon and other mountains the Saxons could not well follow. The country remained independent, under native princes, until Edward I of England subdued it (1282) and gave to his infant son the title "Prince of Wales." That son later succeeded to the throne of England, and from then on the heir to the English throne has usually been known as the Prince of Wales. During the reign of the Lancastrian Henry IV, Owen Glendower carried on a war for Welsh independence and won his place as the chief of Welsh heroes. But the reign of Henry V saw Wales once more subdued.

THE CITY HALL OF CARDIFF



Cardiff, the chief city of Wales, is proud of the fine public buildings that are grouped around three sides of Cathays Park. The City Hall shown here was completed in 1906.

The Tudor Henry VII developed a Council of Wales, a kind of subordinate Privy Council, which gave close attention to the administration of the country. The Tudor sovereigns, being of Welsh descent, took an especial interest in the country and gave it representation in Parliament and a local organization similar to that of the English in place of the old tribal law and organization. English common law and English judges and juries brought order and peace to the country. "A better people to govern, Europe holdeth not," said Sir Henry Sidney, who was sent by Elizabeth to rule Wales.

Religions and Industries

The Reformation was not kindly received in Wales, in the beginning. The people found the Established Church of England not so considerate of their customs as Rome had been, and Catholicism always maintained a foothold. Puritanism later won many adherents; and in the 18th century the Wesleyan movement took fast hold, though the people wished to remain within the Church of England as Methodists. Today more than two-thirds of the people belong to the Methodist or Presbyterian denominations. A law disestablishing the Church of England was passed in 1914 but was not put into effect until 1920.

The rich coal fields of Wales, which supply the best grades of steam coal, became one of the basic factors in Britain's greatness; they helped build its navy, its industry, its world empire. The history of mining in Wales is one of violent fluctuations in the industry and in the living conditions of the miners. Once, laborers flocked into the mining regions; later, many had to emigrate to escape starvation. Social conditions were deplorable in the early 19th century (*see* Industrial Revolution). After the first World War, all Wales became a "depressed area," with a third of the people at one time living on state relief.

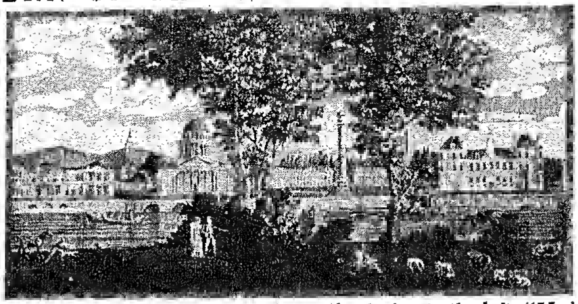
Other industries are smelting and refining copper, zinc, and lead from both local and imported ores. Iron and steel products and tin plate are also manufactured. Welsh industrial centers were heavily bombed by the Germans in the second World War.

Because much of the land is mountainous and the soil is poor and rainfall is heavy, agriculture is comparatively limited, although the most modern farming methods are being adopted. Cattle and great numbers of sheep cover the grazing lands. Oats, barley, wheat, and root crops are grown. Truck gardens are found on the many small farms.

In recent years there has been a marked revival of Welsh nationalism. Not that anyone thinks of independence—Wales is fairly content with its position in the British Empire; but there is a new interest in restoring the Welsh language and in publishing Welsh histories and poems. Welsh music and poetry flourish at the bardic festival—the Eisteddfod—and Welsh folklore is cherished by all. This emphasis on ancient traditions and culture is the keynote of Welsh individuality, which makes its own special contribution to the fabric of British civilization.

WALL PAPER. Early in the 16th century, an inventive genius, probably living in Italy, observed that the decorated paper that was used for lining books might be developed into a cheap and beautiful means of wall decoration. It is now the world's most popular covering for walls. A hundred years passed before it was in general use, and it did not take its present "rolled" form until the 18th century. It is the last word in the long story of the decorative treatment of walls, which began with fresco in ancient Egypt, was continued with mosaic in pagan and Christian Rome, and revived in the Middle Ages (notably in Italy) by

THE PATTERN OF THE PAPER MUST SUIT THE ROOM


A conventional, all-over pattern, suitable for an informal room, forms the design to the left. "Modernist" influence marks the wall paper at the right. In the center, one of the 18th century panorama or scenic papers quaintly depicts the monuments of Paris.

fresco, and by the invention and universal use of arras or tapestry. Tapestry was favored north of the Alps, especially in France; whereas Italy always preferred velvets and damasks. The great cost of tapestry, velvet, damask, and leather, which was tooled, painted, and gilded, led to the invention of paper hangings as substitutes by people of limited means who loved the beauty of colors and patterns.

Origin of Wall Paper

The earliest papers for covering walls were probably derived from domino, checkered, or marbled papers, made in sheets about 12 by 16 inches, for linings of books. By the middle of the 16th century it was a common custom in France to cover walls with these sheets. Flatheaded nails held them in place. The sheets, called "painted paper," were block-printed, and colored by hand with stencils. Checks, wave lines, and colors seldom matched. Designers and manufacturers quickly saw the disadvantages of the small sheets, and the consequent disjointed patterns. Improvement in matching patterns was made by the middle of the 17th century, and continuous rolls, made by pasting sheets end to end, were in use by 1750. Rolls of the type common today were not made until the following century, and were not permitted in England before 1830 because of the revenue tax on sheet paper. The third great improvement was that of printing colors by successively applied blocks. This process demanded great skill, yet it was more rapid than stenciling by hand. This method was used with notable success by Papillon and Chauvau, master and pupil, Frenchmen of the 17th and 18th centuries.

"Flock-papers," a type of wall paper in imitation of velvet and tapestry were sized (*see* Paper) and then covered with fine chopped wool by a process of blowing. They were much in vogue in England, and were sent to France in great numbers at the end of the 18th century. The French used chopped silk in the same way to imitate damask. The designs and colors of these papers were closely copied from the beautiful materials for which they were substitutes. They were regarded, as they are today, with great admiration. They were rarely pasted upon walls but generally placed upon linen, which was stretched across wooden frames set against the walls. They could be moved from house to house—a practise not uncommon with other fine papers in the days when such articles were very expensive.

During the second half of the 18th century, panel papers came into fashion, and great artists designed them, such as Prieur, a Frenchman, said to have produced the most beautiful wall papers ever made, and the Englishman, Jackson. The panels, each of which had a complete scene, were fitted to the various wall spaces of a room. Each panel was bordered by a molding, and had a certain amount of plain background about it. Thus, these panels were pictures, both in themselves and in their treatment. They were often printed with oil colors. Reveillon of Paris was famous for his panel papers. Subjects such as Venetian scenes, Roman ruins, reproductions of well-known paintings in full color, and statues in black and white were among the most popular. These led to costly scenic, or continuous panorama papers, and landscape papers. They had a great vogue in France and America, but were never popular in England. They are still expensive because the greatest care and skill are called for in printing from hundreds of hand-manipulated blocks.

Chinese Art in Wall Paper

Outside of Europe, the art of designing and making beautiful wall paper was notably advanced by the Chinese. The great trading companies, Dutch East India, English East India, and French East India, introduced Europe in the 16th and 17th centuries to the beauty of oriental wares. They flooded the West with a great variety of interesting and lovely merchandise (*see* Furniture). Among the articles were fascinating hand-painted papers. The earlier ones had for their subjects flowers and birds; the later, after 1750, landscape and figures. The charm of Chinese wall papers is due to bright harmonious colors, a general lightness of tone which increases the sense of brightness, creamy backgrounds suggestive of porcelain, extreme naturalism on the one hand, as in the painting of a flower or a butterfly, or, on the other hand, fantasy raised to the point of absurdity, as when three vases are shown walking upstairs. The demand being instantly greater than the supply, copying actual Chinese papers, and designing in their manner quickly followed.

The story of American wall paper before and since the Revolution is a record both of foreign influence and native originality. At first, of course, imported papers were the only ones, but by 1750, a Philadelphia maker had established a good business in manufacturing them, and soon thereafter, manufacturers in other cities increased the industry. In style they followed pretty closely the papers made abroad, but native ability and taste soon created new styles, just as they did in furniture and silver.

How to Choose Wall Paper

The historical approach to the appreciation of wall paper suggests the practical question: How may I use this beautiful decorative article to the best advantage? In choosing wall paper, one may well ask—is the room large or small, light or dark, a living-room, bedroom, or staircase hall? Is it a room to be used all the time, or is it a "dress-up" room? Has it a cool or a warm exposure? Do you want it cheerful, or solemn, or stately? (*See* Fine Arts; Interior Decoration.) There are several well-established principles in determining the right wall paper. Never choose one merely because it appeals to you in the shop. Have two or three rolls sent home and put them up in the room to be decorated. You may find a paper that is beautiful in itself, but will not harmonize with the place for which you want it. Or you may discover that the pattern repeats itself so frequently that it is very tiresome, or that it is built on diagonal lines which carry your eyes back and forth from floor to ceiling in a way that makes you dizzy. Again, the pattern may be a charming small element such as a sprig of leaves, or spray of flowers which seen in a single roll has real beauty, but seen over an entire room and from a distance is merely a meaningless spot. Wall paper is an important part of screens, which are among the most decorative as well as serviceable pieces of furniture for any house. A glance at Chinese and Japanese screens will show their decorative value. Screens covered with Chinese, Louis XVI, or William Morris tapestry papers, or with panel paper are very popular. Standing between two rooms, in a double door, a screen with gay designs and colors on one side may give life to a dull room, and on the other side its subdued designs and colors may strike a note of restfulness in a gay room. Finally, a gold screen covered with Chinese gold paper will add a note of quiet elegance to an entire room, or form a delightful background for a green or a blooming plant. The two, in combination, are often enough to decorate a good-sized apartment. This is in line, of course, with the recent fashion of papering entire rooms with gold or silver paper, or figured papers —which have gold or silver backgrounds.

WALLACE, SIR WILLIAM (1270?–1305). We know very little of the early life of Wallace, Scotland's national hero, until the time when as a young man he killed an Englishman who insulted him, and for this was outlawed. Then it was that he collected a little band of followers and began the struggle against the English rule of Edward I. Gradually the number of his followers grew until all Scotland was ablaze with rebellion. As soon as an English army approached, however, the jealous and contentious Scottish nobles deserted. In spite of this Wallace defeated and almost destroyed the English army at Stirling Bridge (Sept. 11, 1297), drove the enemy entirely out of Scotland, and devastated the whole northern part of England. As a reward for this Wallace was elected guardian of Scotland and showed himself a successful governor until a new and larger English army was sent against him. Again the nobles deserted, and on July 22, 1298, he was overpowered and vanquished with great loss in the battle of Falkirk.

Again he sought refuge in the mountains and for several years carried on irregular warfare against the English. But at length he was captured, probably through the treachery of a Scotchman, and taken to London where he was tried, condemned cruelly, and executed as a traitor. He had failed in freeing his country from the yoke of England, but he had inspired others to carry on the struggle and a few years later Scotland's independence was secured under Robert Bruce.

WALNUT. Among the handsomest and most valuable of all trees are the walnuts. For fine furniture and cabinet work, the beauty and quality of walnut wood is equaled only by mahogany and oak. In the United States and England, walnuts are considered the choicest of all nuts.

The walnuts are widely distributed through North and South America, the West Indies, southeastern Europe, and southern and eastern Asia. Six species are native to the United States and one Asiatic species, the English or Persian walnut, is raised commercially on the Pacific coast. Of the native species, the most important are the black walnut and the butternut or white walnut (*see* Butternut).

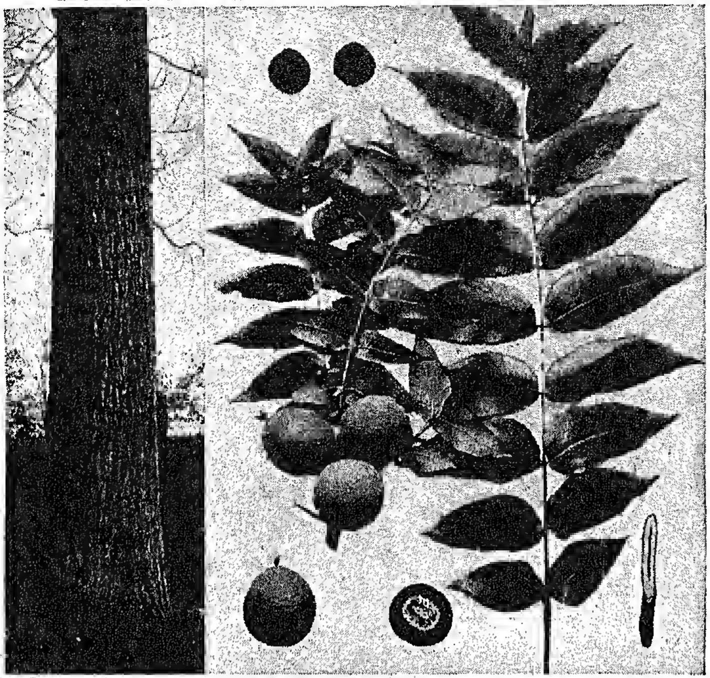
The Most Valuable Species

The black walnut (*Juglans nigra*) ranges from middle New England to northern Florida in the East, and from Nebraska to eastern Texas in the West. No great forests remain, but the trees have been widely planted singly, in small groves, and along country roadsides. They grow best in valleys and bottom lands where the soil is rich and moist.

The straight trunk, dark brown and deeply furrowed, rises 70 to 100 feet, with a girth of 2 to 6 feet. With its rounded, symmetrical crown and plumy yellow-green foliage this tree is ornamental as well as useful. The leaves are one to two feet long, with 15 to 23 lance-shaped leaflets, each about three inches long. The heartwood of the black walnut is the finest wood for furniture, interior finish and gunstocks. It is hard, straight-grained, and resistant to fungi and insect pests. It does not warp or split, is easily worked with tools, and takes a high polish.

The English walnut (*Juglans regia*) is not a native of England but of Persia. It is a moderate-sized tree, 40 to 70 feet high, with smooth gray bark. The leaves are 8 to 16 inches long, with 7 or 9 leaflets. The English walnut grows best in rich, deep, well-irrigated soil, in a climate of high humidity and small daily range of temperature. From it is obtained the beautifully grained wood known as Circassian walnut. More English walnuts are marketed than any other tree nut. For these the tree is raised commercially chiefly in southern California. The nuts are harvested usually by migratory labor. They are washed, dried, culled, and

THE BLACK WALNUT TREE AND ITS FRUIT

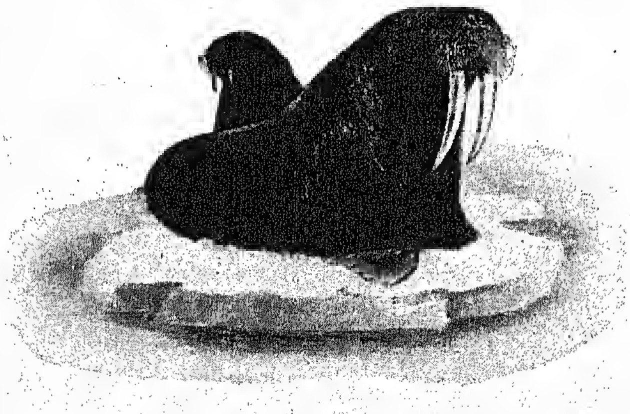


On the left is the straight dark trunk of a black walnut tree. Sometimes the trunk rises 40 to 60 feet before it branches. In the center is a branchlet with three nuts attached, and below a fallen one. These nuts still wear their thick husks. Above are two nuts with the husks removed, showing the black shell. The shells are extremely hard. Below is a cross-section of a nut.

sacked on the farm. They then go to a central packing house where they are bleached, graded, and packed. They may be marketed either shelled or unshelled.

WALRUS. "Whale-horse" is the meaning of this creature's name, and he lives up to this description. He is closely related to the seal and sea lion, but has enormous down-turned tusks, or canine teeth, projecting from the upper jaw, sometimes reaching a length of 30 inches. The tusks are of solid ivory, and are useful in defense and as an aid in digging and in climbing. The thick wrinkled skin of the old animals is almost hairless. The young ones, however, are quite thickly covered with hair of a pale brown color.

THE "OLD MAN" OF THE ICE FLOES



The Walrus is often to be seen riding gravely upon a cake of floating ice, his great hanging teeth giving him the appearance of an old man with a parted beard.

The walrus has a thick, clumsy body, deepest at the shoulders. The head is rounded, with a short broad muzzle, on either side of which is a bunch of stiff bristly whiskers. The feet, or flippers, which are adapted for swimming, are furrowed so as to hold to smooth surfaces, but do not enable the animal to move about very readily on land. Walruses normally reach a length of from 10 to 12 feet and a weight of about 2,000 pounds, though some are as much as 20 feet long.

There are two living species, one found in the Atlantic and one in the Pacific. The Atlantic form, *Odobenus rosmarus*, is found on the coast of Labrador and Hudson Bay, and formerly extended further south. The Pacific form, *Odobenus obesus*, lives farther north, being rarely found on the mainland. Both species feed largely on clams and other mollusks, which they dig from the sea-bottom with their tusks. Their fondness for oysters is alluded to in the poem of "The Walrus and the Carpenter" in 'Through the Looking-Glass'.

Walruses visit islands and ice floes, and congregate in considerable numbers during the breeding period. They have a strong maternal instinct, and a mother walrus will fight fiercely for her young. They are hunted for their hides, oil, and ivory, and their flesh is relished by natives along the Arctic coast. Their decrease is a very serious loss to native Alaska. The polar bear is their most dreaded natural enemy.

WANDERING JEW. When Christ bearing his heavy cross was on his way to Calvary, he paused, according to a well-known legend, for a moment's rest before the door of a Jew named Ahasuerus. Cursing, the man struck him, and cried out: "Go, why dost thou tarry?" For an instant Christ looked at him without speaking. Then he replied, "I go, but thou shalt tarry till I come again." When the Jew came to himself he was filled with horror, fear, remorse; but from that day to this he has never ceased to wander restlessly from place to place.

There are several versions of this medieval story, some describing the Jew as a cobbler of Jerusalem, some as the carpenter who made the cross for Christ, and others as the doorkeeper of Pontius Pilate. The version given above first appeared in a pamphlet printed in Leyden in 1602, in which the bishop of Schleswig told of meeting the Wandering Jew at

Hamburg. Eugène Sue used this legend for the plot of his novel, 'The Wandering Jew', and Lew Wallace re-created the story again in 'The Prince of India'.

The name Wandering Jew is also given to any one of several ornamental trailing plants, often cultivated in hanging baskets. Perhaps the commonest of these is the branching spiderwort (*Zebrina pendula*) from Mexico; it has curiously striped leaves, often purplish beneath, and inconspicuous flowers.

WA'PITI. The wapiti belong to the red deer group of the deer family, and inhabit North America, Europe, and Asia. Those of North America are the finest and largest, sometimes attaining a weight of more than 800 pounds. Their antlers are cylindrical and widely branched, four or five feet long and three or four feet apart at the points. The early settlers called them "elk" and they are usually erroneously so called at the present time. Originally the wapiti was the most wide ranging of American hoofed game animals. It was found over practically the whole continent from southern Mexico to Hudson Bay, and from Labrador to California. It seemed equally at home near sea level and above the timber-line of lofty mountain ranges. The wapiti has become exterminated to such an extent that it is now found only in Canada, Wyoming, Colorado, and the Pacific coast states. The larger number of the 40,000 or more survivors have found a refuge in the Yellowstone Park region. Wapiti thrive readily in captivity.

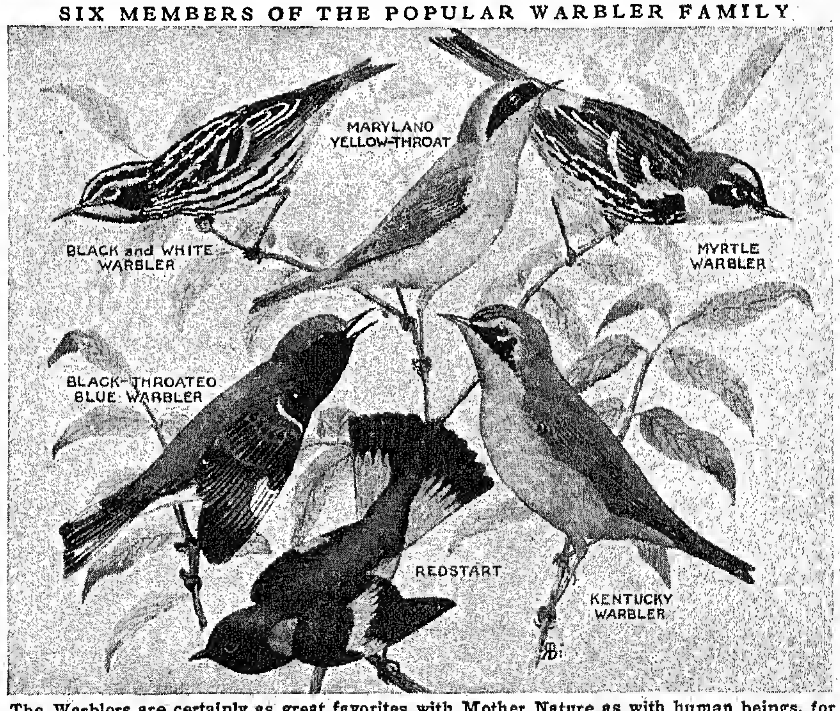
WARBLER. In every orchard warblers are welcome visitors. They come with the blossoms, and though seemingly at play among the trees, they really are working busily. There are but few leaves or buds that they do not inspect, and fruit-growers owe much to the vigilance of these little birds, who rid trees of the insects that menace the orchard output.

Warblers feed chiefly on insects. They relish the eggs as much as the larvae; the nymph as much as the adult. Their hunting ground is usually in forests, where they nest among the trees. A few live in the open on or near the ground. Some are expert flycatchers; others creep about the tree trunks, searching the bark for insects. Many have attractive songs, but others are songsters of inferior merit. Each species wears its own coat of many colors—black and white, grays and greens, splotches of red, with many patches of yellow.

The warblers of the Old and New Worlds belong to different families. The New World family (*Compsothlypidae*) has over 150 species. Of these one of the most familiar in the United States is the myrtle warbler. (For illustration in colors, *see* Birds.) The yellow warbler is a summer resident of lawns and parks. The black and white warbler runs over the bark of trees like a nuthatch. The black-throated green warbler nests in pine woods from southern New England northward. The largest member, the yellow-breasted chat, is noted for its night song.

Besides the species having the name warbler, a favorite member of this family is the redstart, a pert, active little bird about five and one-half inches long. It has glossy black plumage, with orange red on the wings and tail, and white underparts. It is essentially a bird of the eastern United States and Canada, although it is not unknown in the west. The Wilson warbler wears a black cap that contrasts nicely with his yellow and olive-green plumage; and you could never mistake the Maryland yellow-throat who, like a bandit, wears a black mask over his face. The ovenbird is one of our best known warblers. He is very common on the floor of the forest, and always he is calling "teacher, *teacher*, TEACHER." He builds a domed-over nest of grass that looks like an old-time Dutch oven—that is why he is called ovenbird.

SIX MEMBERS OF THE POPULAR WARBLER FAMILY



The Warblers are certainly as great favorites with Mother Nature as with human beings, for she seems to have tried to see in how many ways she could dress them up. A mere list of the names of the different Warblers looks like a long spelling lesson. Here are just a few of the best known.

Scientific name of yellow warbler, *Dendroica aestiva;* black-and-white warbler, *Mniotilta varia;* black-throated green warbler, *Dendroica virens;* redstart, *Setophaga ruticilla.*

The AMERICAN WAR *of* 1812

How It Grew Out of the Gigantic Struggle between England and Napoleon—Stirring Exploits of America's Naval Heroes—The Strange Treaty that Concluded It

WAR OF 1812. If the god of war ever laughs up his sleeve, he probably did so over the War of 1812. Of all the wars which have been fought by the United States, this conflict stands out as the most singular in its causes, character, and results. The issues for which it was begun had practically disappeared before the first gun was fired, and the most important battle of the war was fought after peace had been declared. It was waged by the West and Southwest largely in behalf of the interests of New England, which, strangely enough, bitterly opposed it from the beginning. It was marked by a series of humiliating defeats for the American land forces which had confidently expected to conquer Canada in a summer, while on the other hand the insignificant American navy of less than 20 ships, on which no one had reckoned, met with successive brilliant victories at sea. Terminated finally by a treaty in which no mention was made of the causes of the conflict, the war is without a parallel in the annals of American history.

Causes of the Conflict

The war had its origin in European affairs. In the gigantic conflict between Great Britain and Napoleon, Great Britain gained control of the seas by her victory over the combined French and Spanish fleets at Trafalgar (Oct. 21, 1805), while Napoleon a few weeks later gained supremacy on land by his defeat of the Austrians and Russians in the winter battle of Austerlitz. Henceforth, as someone has said, the war between the two belligerents was like a conflict between a land animal and a sea animal: neither could or would grapple with the other in its chosen element.

This situation led to a fierce commercial struggle in which the interests of the United States became vitally involved. Believing that the source of Britain's strength lay in her commerce, Napoleon issued a series of decrees during 1806 and 1807 which provided that the ports of Europe under his control should be closed to British goods; by thus depriving England of her chief markets he hoped to force her to sue for peace on his terms. The British government, on the other hand, in retaliation for the Continental system, as Napoleon's plan was called, issued various Orders in Council forbidding neutral vessels to trade at any port which was closed to the British flag unless such vessels had first touched at a British harbor and had paid duties upon their cargoes to the British government. The action of both belligerents was in flagrant violation of international law. As Jefferson said, "England seemed to have become a den of pirates, and France a den of thieves."

The effect of Napoleon's Continental system and of Great Britain's Orders in Council was to threaten with ruin the growing commerce of the young republic across the sea. During the preceding 15 years the shipping of the United States had multiplied almost eight-fold, her exports had increased 400 per cent, her carrying trade had grown enormously, and the wages of her sailors had been tripled. By the policy now adopted by the warring countries this prosperity was seriously menaced, for, as someone put it, the new method of making war was like a bull-fight: Napoleon was the bull, England the toreador, and America paid the expenses of the entertainment. Interference with neutral trade, in short, was the first cause of the conflict.

A second cause of the War of 1812 was the impressment of American seamen. In common with other countries at the time Great Britain did not recognize the right of naturalization; her theory of citizenship was "Once an Englishman, always an Englishman." Least of all was she disposed, in the midst of grave national danger, to admit that British seamen, attracted by the higher wages, better food, and more kindly treatment on American vessels, could desert their ships in American harbors and enter American service under the protection of so-called naturalization papers. Accordingly, her naval commanders had strict orders to stop neutral ships and make a diligent search for deserters.

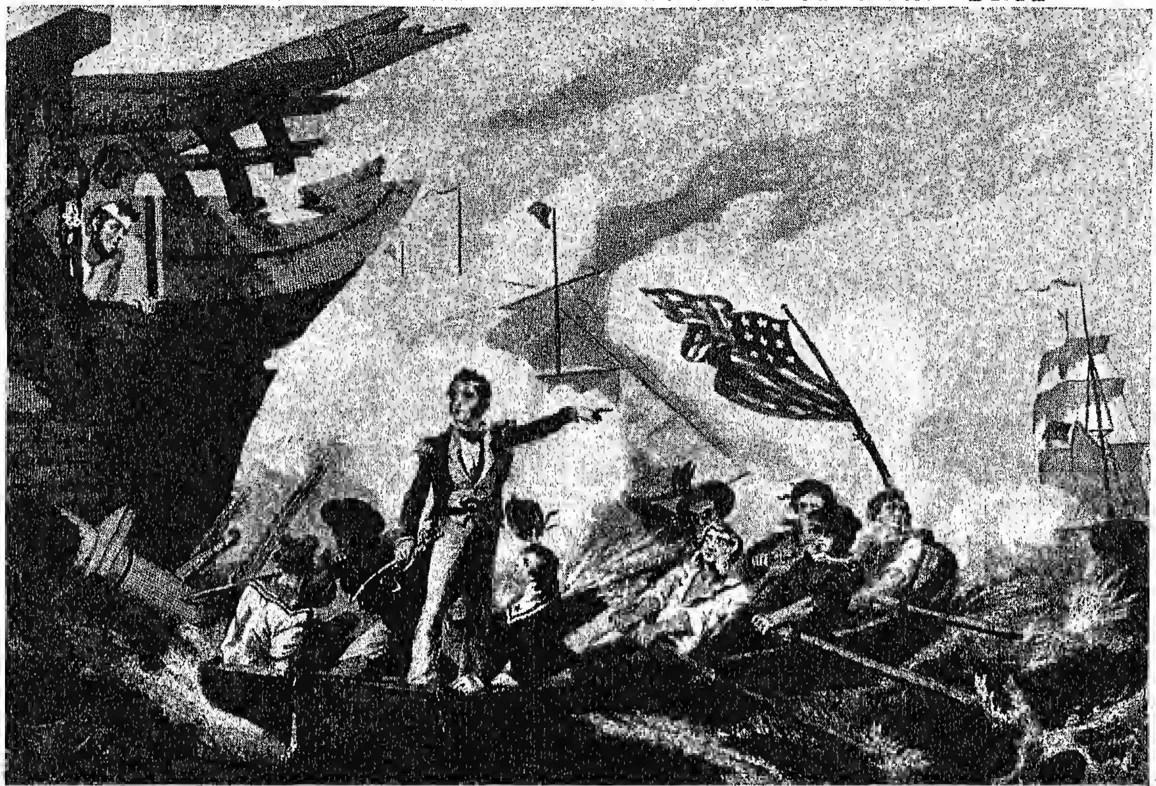
This policy of impressment proved especially obnoxious to the United States because, owing to the difficulty of distinguishing between Englishmen and Americans, many of the impressed sailors were native-born Americans. Between 1803 and 1810, in fact, approximately 5,000 American citizens were officially reported as having been forced to serve on British ships. While such sailors were released when their identity was established, this was a difficult thing to prove and occurred in most instances only after the impressed men had served under the British colors for a year or two; of the number mentioned above, for example, only 1,361 were released.

The "Chesapeake Affair"

A peculiarly intolerable instance of the exercise of the right of impressment was the unprovoked attack on the American frigate *Chesapeake* by the British ship *Leopard* (June 22, 1807), made because the American commander refused to permit his vessel to be searched for deserters. In this encounter three Americans were killed, eighteen were wounded, and four men—three of them Americans—were taken on board the British ship. Four years later, a somewhat similar controversy had a different outcome for, in this instance, the American frigate *President* forced the British sloop of war *Little Belt* to strike her colors.

A third cause of the war was the belief—especially strong in the West—that the British had for years incited the Indians to attack American frontier settle-

COMMODORE PERRY AT THE BATTLE OF LAKE ERIE



Few deeds have so fired the imagination as the heroic conduct of Commodore Oliver Hazard Perry at the Battle of Lake Erie. After his flagship, the *Lawrence*, had been literally shot to pieces, and nearly all its crew killed or wounded, Perry put off to the *Niagara* in a small boat under heavy fire, and soon after forced the entire British squadron to strike its colors.

ments. Although the truth of this charge is now questioned, it seemed then to be confirmed by British guns and powder of British origin found by William Henry Harrison among the effects of the Indians whom he defeated in 1811 at Tippecanoe (*see* Harrison, William Henry), and by the flight of the Indian leader Tecumseh to Canada after that defeat.

Numerous efforts to avoid war had been made by the American government. Upon Jefferson's recommendation Congress passed Embargo and Non-Intercourse acts. These were designed to keep American ships at home and to secure justice from the belligerents by depriving them of American goods which—so Jefferson thought—were essential for their welfare (*see* Embargo Acts). While the embargo did, indeed, injure British manufacturers, it proved even more harmful to American shippers and farmers; it was, in fact, like "holding the blade of the sword and striking the enemy with the hilt." Finally, during Madison's administration an act was passed repealing the Non-Intercourse Act, but offering, in case either belligerent should revoke its decrees against neutral commerce, to forbid trade with the other in case it, too, did not withdraw its decrees within a given time. Shortly after the passage of this act Napoleon, who never hesitated to give or break a promise if by so doing he might gain his end, notified the American minister in Paris that his decrees were revoked. This revocation, he added, was on the understanding that if England did not revoke her Orders in Council, the United States should "cause their rights to be respected." Having good reason to suspect that Napoleon had not withdrawn his decrees, the British refused to recall their Orders in Council and continued their interference with American trade.

The "War Hawks" Demand War

Further delay seemed impossible. Madison, threatened with a loss of the renomination for the presidency and urged to action by a group of fiery young Congressmen led by Henry Clay—the "War Hawks," they were called—finally sent a strong message to Congress reviewing the British aggressions and recommending war. Accordingly, on June 18, 1812, by a vote of 79 to 49 in the House and of 19 to 13 in the Senate—almost all the votes against the bill were cast by New England Federalists—war was declared against Great Britain. Five days later the Orders in Council were revoked, but the revocation was couched in such unsatisfactory terms that, although the British proposed a suspension of hostilities, their proposal was rejected and the war ensued.

The American leaders expected to conquer Canada in short order and to dictate terms of peace in Quebec or Halifax. But the government was totally unpre-

pared for war, the regular army was poorly drilled and officered, and New England, then a large section of the country, was emphatically opposed to the conflict. Instead of a triumphal march into the enemy's territory, therefore, the first year of the struggle saw the disgraceful surrender of Detroit by General William Hull, the loss of Mackinac, the burning of Fort Dearborn (where Chicago now stands), and the whole Northwest in danger. An invasion of the Niagara region ended likewise ingloriously in the capture of the entire American force.

The next year opened no better. An effort to recapture Detroit ended in defeat at the River Raisin, in Michigan, and in the massacre of the wounded by the Indians. Later in the year an attempt to capture Montreal was also unsuccessful. Meantime, however, Commodore Oliver H. Perry had won a brilliant victory on Lake Erie (Sept. 10, 1813), and his famous message, "We have met the enemy and they are ours," inspired the Americans to new effort (*see* Perry, Oliver H.). His success opened the way for Gen. William H. Harrison to recapture Detroit and recover Michigan. Following the British into Canada, Harrison defeated them at the battle of the Thames (Oct. 5, 1813). In spite of this victory the end of the second year of the war saw the conquest of Canada almost as remote as it had been at the beginning.

In the meantime a number of stirring duels had been fought on the high seas. The American navy, while small—it numbered less than 20 ships as compared with a thousand under the British colors—was composed of well-built, swift-sailing vessels, manned by sailors who had no superiors and commanded by officers who for gallantry and daring have never been surpassed. Within half a year after the war began England had lost six vessels and captured none. Of 13 duels between well-matched antagonists, the Americans won 11.

The 'Constitution' and the 'Guerrière'

Especially famous among these combats was the victory of the American ship *Constitution*, commanded by Capt. Isaac Hull, over the British frigate *Guerrière* (Aug. 19, 1812). "In less than thirty minutes," the American commander reported, "she was left without a spar standing, and the hull cut to pieces in such a way as to make it difficult to keep her above water." Equally thrilling, although with a different outcome, was the defeat of the *Chesapeake* by the British ship *Shannon*. In the short fierce action which ensued, Captain Lawrence of the *Chesapeake* was mortally wounded. As he was carried below he gave the famous command, "Don't give up the ship." So withering was the British fire, however, that the *Chesapeake* was soon captured and was taken as a prize to Halifax (*see* Lawrence, James). By the end of 1813 the Americans had captured or sunk 26 British war vessels and had lost but 7. The preponderance of numbers, however, finally told against them and before the end of the war the British had sunk, captured, or blockaded every American frigate.

The year 1814 boded ill for the Americans. The defeat of Napoleon made it possible for the British to dispatch large reinforcements of veterans to their forces on this side of the water. Nevertheless the Americans began a third invasion of Canada. It resulted in the indecisive battle of Lundy's Lane, the bloodiest battle of the war, in which Gen. Winfield T. Scott distinguished himself. Although the Americans held their ground, their progress was checked and in the fall their troops were withdrawn. The British now attempted to invade New York, but failed, owing to the defeat of the British fleet on Lake Champlain by Commodore Thomas Macdonough.

The Capture of Washington

In the meantime an effort by the British to create a diversion in the Middle States, while humiliating to the Americans and disgraceful to the invaders, also resulted in failure. Appearing in the vicinity of Washington in the summer of 1814, General Ross with an army of 4,500 men, after overcoming feeble resistance from a superior American force, took the capital, and, on the ground that the Americans had destroyed the government house at York (now Toronto), set fire to the White House and some other public buildings. The President and the Cabinet fled, while pretty Dolly Madison bundled up the most precious White House treasures, including Washington's picture and the original draft of the Declaration of Independence, and carried them to safety. General Ross then moved against the rich city of Baltimore, but here at last he met a spirited resistance and was forced to retreat, and sailed away down the bay. It was during the bombardment of Fort McHenry, one of the defenses of Baltimore, that Francis Scott Key, a prisoner on board a British war vessel, wrote 'The Star Spangled Banner'.

Peace was made Dec. 24, 1814, but before the news reached America the most creditable land battle of the war had been fought at New Orleans, Jan. 8, 1815. Here Andrew Jackson and his band of frontiersmen, who during the preceding year had crushed the Creek Indians at Horseshoe Bend in Alabama, completely defeated a larger force of British veterans who had fought against Napoleon in Europe (*see* Jackson, Andrew). This victory aroused intense enthusiasm throughout the country, although it was soon learned that the sacrifice of life had been useless. The treaty had been signed for more than two weeks before the battle was fought.

Throughout the struggle the majority of the New Englanders had steadily opposed "Mr. Madison's War," as they scornfully called the conflict. They had refused to allow their soldiers to fight outside of their own states. Their representatives in Congress had opposed all bills for raising money and men. And finally, in December 1814, aroused by the destruction of their commerce and fisheries, which were New England's chief interests, delegates from five states met in secret convention at Hartford, Conn., and proceeded to draw up a series of amendments to the Con-

stitution with a view to protecting their own interests against those of the South and West. No treasonable intention could be proved, but behind the whole work of the convention was the implied threat to secede if their demands were rejected.

The Treaty of Peace

Before their demands could be presented to Congress, news arrived that the treaty of peace had been signed at Ghent on Christmas Eve, 1814. The treaty was a strange one. Not a word was said in it about the Orders in Council, the searching of American ships for forbidden goods, or the impressment of American seamen—the chief reasons why the United States had gone to war. The return of peace in Europe had removed the occasion of trouble, however, and both sides were glad to bring to an end a conflict which had brought no great glory to either. The war cost the United States about $100,000,000, and 21,000 sailors and 30,000 soldiers were killed or wounded. But, on the other hand, the united action against a common foe and exultation over victories won by men from all parts of the Union did much to create a truly national spirit which was eventually to take the place of the old spirit of loyalty to the state. The war also played a notable part in bringing into prominence men like Clay, Calhoun, Webster, and Jackson, who for a generation shaped the national policies of the United States. (*See also* Jefferson, Thomas; Madison, James; Neutrality Policy of the United States.)

WARSAW. For four centuries since it became the capital of Poland, Warsaw (Polish *Warszawa*) has been both the symbol and the highest expression of Polish culture. But throughout its history, Warsaw, like all Poland, has suffered the ravages of wars and conquest. The darkest passage in its tragic story was written in 1939, when Germany took over the city after battering it into submission.

When it was made the capital of the newly formed kingdom of Poland in 1550, Warsaw was already old. It is believed to have been settled as early as the 9th century. After 1655 the weak Polish state was never able to hold Warsaw securely for any great length of time, and the city was dominated in turn by Sweden, Russia, and Prussia. As capital of the Duchy of Warsaw, it enjoyed a brief period of independence bestowed by Napoleon in 1807, but in 1813 it was brought again under Russian rule. During the World War of 1914–1918 the city was captured by the Germans, who held it until peace restored a free Poland, with Warsaw as its capital.

During the 19 years of the republic, much of the ancient city was rebuilt and modernized. But many of the fine new buildings, parks, and broad boulevards with which the Poles had adorned their capital were demolished in the 20 days of siege and bombardment that ended in the surrender of Warsaw to the Germans on Sept. 27, 1939. (*See also* Poland; Europe.)

This varied, turbulent past pervades every aspect of the city. The central point is Sigismund Square, where stands the ancient royal castle. Radiating from the square are broad avenues, which under the republic were thriving commercial centers and gay promenades. North of the castle is the old town, which retains the crooked streets and quaint old buildings of the Middle Ages. Here, rising massively, is Warsaw's oldest church, the Cathedral of St. John, built in the 13th century. Under German rule in 1940 this section was turned into a ghetto, enclosed by an eight-foot concrete wall, within which the Jews were compelled to live.

As a city of culture, Warsaw, when governed by the Poles, had few peers. In the lovely 18th-century gardens of Lazienki Park, there was a world-renowned open-air theater. The University of Warsaw, founded in 1817, had a library of 500,000 volumes. The city's museums contained priceless treasures of art.

Geographically, the most striking feature of Warsaw is that, surrounded by almost entirely flat country, it rises steeply to a height of 125 feet from the southwest bank of the Vistula River. Bridges connect it with the suburb of Praga on the opposite bank. Its economic life was long based on the grain, potatoes, sugar beets, and live stock produced in the country around; but under the republic manufacturing industries were also developed.

Situated in Europe's great central lowland, Warsaw was for centuries a center for the trade of these fertile plains. The city and its surrounding territory lay athwart the major land route between western and eastern Europe, and the Vistula carried a great commerce north to the Baltic Sea. Distribution of products in modern times was facilitated by railroad connections with Berlin, Moscow, and other large cities. Population, about 1,265,000.

WARTS. The ordinary wart is one of the most conspicuous, and yet one of the least dangerous, of all skin afflictions. It is an outgrowth of the upper layer of the skin itself, and has a scaly top and fibrous roots. Under the microscope, it is seen to consist of a delicate framework of blood vessels, supported by fibrous tissue. Soon after it ceases to grow, it is likely to dry up, leaving no mark. This tendency of warts to disappear of themselves has contributed to the survival of old superstitions that they can be charmed away by magical practises.

The belief that warts are caused by handling frogs and toads has no basis in fact. The commonest cause, it is now believed, is infection with a filtrable virus. Infection seems often to follow continued irritation of the skin or bruises and scratches. Children more often develop warts than do adults, perhaps because they are more likely to suffer such minor injuries. Some experiments seem to indicate that warts are slightly contagious.

It is wise to shield warts with bandages, because any irritation or injury may cause them to become infected. They should be removed only by a physician, for unskilled attempts to treat them may cause serious infection. Warts may be removed easily by X-ray, radium, or the electric needle, or they may be burned

off by means of tincture of iodine or nitrate of silver.

Some growths, more or less resembling the ordinary wart, are signals for alarm. Growths occurring late in life on the nose, lips, and other parts of the face may be the beginnings of cancers, and should receive immediate attention from a physician. Other warts, called *condylomata*, occur near points of inflammation and may indicate serious disease.

WASHINGTON, BOOKER TALIAFERRO (1856–1915). Born a Negro slave, Booker T. Washington became not only a leader of his race but one of the most prominent educators in America. When the slaves were freed, this little Negro lad went from the Virginia plantation which was his birthplace to Malden, W. Va. By working hard all day in a salt furnace and later in a coal mine, he helped to support the family and studied at night.

At last he was able, "by walking, begging rides both in wagons and in the cars," to travel the 500 miles to the Normal and Agricultural Institute of Hampton, Va. (now Hampton Institute), a famous school for Negroes. Here he remained three years, working as janitor for his education. After his graduation he taught at Malden, W. Va., and later at Hampton Institute. He proved so good a teacher that when a school for Negroes was started in Tuskegee, Ala., in 1881, he was placed in charge. Here he tried to realize the same high ideals that prevailed at Hampton—to make the Negro an intelligent, God-fearing, self-supporting citizen.

He opened the school, known as Tuskegee Normal and Industrial Institute (now Tuskegee Institute), in an old shanty and church. He began with 40 pupils and with himself as the only teacher. But he left it with over 100 buildings, thousands of acres of land, some 1,500 students, and nearly 200 instructors.

To the end of his life, Booker T. Washington endeavored through his work here and through his lectures and writings to uplift his people and fit them for the social and industrial conditions under which they must live, and to promote a better understanding between the white and the black races. His earnestness, his vision, and his practical ability as a reformer and educator brought him world-wide recognition. Honorary degrees were conferred upon him by Harvard and Dartmouth. The best known of his books is 'Up from Slavery', in which he tells the story of his life.

The FATHER *of the* UNITED STATES

Washington's Immortal Work as a Soldier, Statesman, and Patriot—How He Won the Revolution in the Face of Incredible Difficulties and Helped Lay the Foundation of the New Republic

WASHINGTON, GEORGE (1732–1799). The old mansion on the knoll at Mount Vernon, overlooking the Potomac River, has become a shrine. Every distinguished visitor to the United States regards it as part of his duty to lay a wreath before the iron gates of the simple tomb of George Washington, and Martha, his wife, and to inspect the estate to which the "Father of His Country" brought his bride in 1759. From the hospitable portico of the mansion house, the Virginia gentleman rode forth to the Continental Congress in Philadelphia; and back to it he came as the liberator of the United States. Once again he left, to guide the destinies of the new Union; and once more he returned, for a few final months, as one of the great men of the ages. As the years have passed, Washington has loomed ever larger among the loftiest characters the world has known. Congress provided nation-wide celebrations to commemorate the 200th anniversary of his birth, in 1932; but no memorial that can be created by law will equal that which is founded upon affection and appreciation.

Ancestry and Environment

Washington himself knew nothing of his ancestors back of John Washington, his great-grandfather, who emigrated from England to Virginia about 1657. But genealogists have traced the family back to the 12th century, to a descendant of one of William the Conqueror's Norman knights. This ancestor in 1183 became lord of the manor and village of Wessyngton (or Wassington as it is sometimes spelled), on the northern border of England, and assumed the name of the estate as his family name.

The branch of the family from which the President was descended was established in the 16th century at Sulgrave Manor, in Northamptonshire. The grantee of this estate, Lawrence Washington, was mayor of Northampton and a person of consequence. His great-grandson, Lawrence, was an Oxford fellow and later rector of Purleigh, a village about 30 miles northeast of London. The oldest of the rector's six children was John, who came to America in 1657 and founded the American branch of the family.

When John Washington selected as his family seat a tract of 150 acres in Westmoreland County, on the banks of the lower Potomac River, Virginia had a population of not more than 20,000 people. The chief settlements were along the rivers, for the plantations were dependent on water frontage for wharfage. Ships from Europe supplied almost all their manufactured supplies, and carried back tobacco and other products of the fields. The interior of the country was an unknown wilderness. John Washington, however, was looking ahead, and in 1674, in association with Nicholas Spencer, he secured a new land grant, farther up the Potomac, of 5,000 acres. This tract, on Little Hunting Creek, became the site of Mount Vernon.

This first American Washington was well known in the frontier community. In various exploits against

the Indians he won the rank of lieutenant-colonel and the nickname of "Conotocarius," Devourer of Villages. He was elected to the House of Burgesses, and was socially a member of the landed gentry. Of John's son, Lawrence, little is known, but of Lawrence's son, Augustine, the father of George, there is a good record. Evidently a man of foresight and energy, he was active in the management of his plantations, and was also part owner of iron mines near Fredericksburg, on the Rappahannock. Both the grandfather and the father of George added to the Westmoreland plantation until it included all of the peninsula between Popes Creek and Bridges Creek, small streams emptying into the Potomac.

Augustine Washington had four children by his first wife, Jane Butler, and six by his second wife, Mary Ball. George, the oldest child of Mary Ball, was born Feb. 22 (Old Style Feb. 11), 1732. His birthplace is believed to have been the home on Popes Creek, later known as Wakefield.

WASHINGTON'S BIRTHPLACE RESTORED

Upon the old foundations of Wakefield, on Popes Creek, has been built a reproduction of the supposed birthplace of George Washington. It is part of a national monument, which includes the family burial ground and the site of the earlier ancestral home on Bridges Creek, a mile distant.

George's Boyhood

When George was three years old, the family moved to the larger plantation farther up the Potomac. This plantation was called Epsewasson or Little Hunting Creek, the name of the stream it faced. Several years later, Augustine Washington bought a plantation on the Rappahannock, opposite Fredericksburg, to which he moved his family from Epsewasson. Probably the necessity of giving closer supervision to the iron mines in which he was interested was responsible for this last move. This Rappahannock plantation was the scene of those childhood exploits, most of them imagined by "Parson" Weems and narrated in his 'Life of Washington', which once thrilled adults as well as boys and girls. There, according to tradition, he cut down the cherry tree, and explained to his father that he could not tell a lie. There, too, he is supposed to have thrown a stone across the Rappahannock. Perhaps he performed these and many other feats. We may be sure, however, that he lived the normal life of a boy on the frontier, galloping over the fields and meadows as he learned to ride, playing at Indian wars with his brothers and sister, all of them resting from their play to dash to the wharves whenever the ocean-going ships sailed up the river.

Augustine Washington died when George was 11 years old, completely changing all the family arrangements. The farm on the Rappahannock, about 280 acres, was left to George, Epsewasson went to his older half-brother, Lawrence, and the plantation where George was born, to the other half-brother, Augustine. Lawrence had married his neighbor, rich, charming Anne Fairfax. Lawrence made additions to the house at Epsewasson, and renamed the estate Mount Vernon, in honor of the admiral under whom he had served in the West Indies. Augustine, too, had married, and was living the easy life of a prosperous planter.

After the father's death, it was decided that Mrs. Washington and the younger children should remain on the Rappahannock, but that George should go to live with his brother Augustine, because Henry Williams' school, one of the best in the colony, was only a short distance away. At school George became a leader in all games and sports, especially running, jumping, and riding. There was plenty of hunting and fishing, many boys and girls of his age lived in the neighborhood, and a continuous round of parties and visitors was stimulating to the children. George spent much time in Augustine's fine library, and about this time also became interested in surveying. When he was 14 there was some talk of sending him to sea; one version says that his luggage was on board a ship anchored in the Potomac when his mother changed her mind and withdrew her consent.

In spite of the fact that much of his boyhood was spent away from his mother, she had great influence over him, and in later years he often said that all that he was he owed to her. The Ball family was established in Virginia about 1650 by Col. William Ball. Mary Ball, his granddaughter, was born in 1708. Although the Balls were not rich, Mary Ball, an orphan at the age of 13, had always lived well, herself owned 400 acres of fine Virginia land, had her own riding horses and personal maids, some jewelry, and proper household equipment. She was popularly called the "belle of the Northern Neck" (as the part of Virginia between the Potomac and the Rappahannock was known), and seems to have had numerous suitors. She was interested in none of them until she met Augustine Washington, and married him on March 6, 1730. Many years later, George Washington Parke Custis, the President's step-grandson, wrote that she was "plain, dignified, sincere, strong in the possession of the homely and

homelike virtues, absolutely devoid of vanity and ostentation. . . . No hysterical excitement ever carried her out of the bounds of her reserves. Though apparently endowed with equability of temperament, Mary Washington's nature glowed with a suppressed fervor which transmitted itself to her son and in him became power for endurance, passion for command, ambition to do and dare."

Mary Washington's family consisted of six children, George, Elizabeth, Samuel, John Augustine, Charles, and Mildred, the last of whom lived only 14 months. The two half-brothers, Lawrence and Augustine, were 14 and 12 years older than George, but the relations between them were always affectionate. George, more than the younger children, was accepted by their friends as one of their circle, which included some of the most interesting people in the colony. One of these was Lord Fairfax, cousin to Lawrence Washington's wife, master of more than 5,000,000 acres in Virginia, all inherited from his maternal grandfather, Lord Culpeper.

Washington's First Job

Lord Fairfax was much impressed with the character of young George, and with the ability he had already displayed as a surveyor. George had made his first surveys when he was about 14, and about three weeks after his 16th birthday he was engaged by Fairfax to aid in the surveys of his holdings beyond the Blue Ridge. The work was hard and dangerous. Like any boy on his first real job the pay he received was very important. In a letter to a friend he wrote, "A doubloon is my constant gain every day that the weather will permit my going out, and sometimes six pistoles." When we consider that a doubloon was the equivalent of about $15, and four pistoles made a doubloon, this seems remarkable pay for a boy of 16.

The surveys for Lord Fairfax lasted more than a year. At the end of that time, partly through the influence of Fairfax, Washington received his first public office, surveyor of Culpeper County. The county records show that he took the oath of office on July 20, 1749, when he was little more than 17 years old. In the intervals between surveying trips, Washington's activities seemed to be leading him directly into the routine of the country gentleman. And in the open life, with its sport, adventure, and hardship, he was always at his best. Tall—he was six feet two—powerful, erect, he took full share in the social affairs of the young Virginians. And he had so healthy a love for clothing and the adornment of life that he was never too busy to write to his London agents with full details of the pipings and the pockets of his clothing, and of the tableware, and the ornaments for his drawing-rooms.

RULES OF CIVILITY—*From George Washington's Copybook*

BEFORE he was 16 years old, George Washington copied down 110 "Rules of Civility and Decent Behaviour in Company and Conversation" as an exercise in penmanship. Thus early did Washington learn the secret of gracious manners and apply it to his own gentlemanly conduct. The "Rules" cover ten pages in one of Washington's copybooks now in the Library of Congress at Washington. Originally published by French Jesuits around 1595, the "Rules of Civility" were translated into English with various changes and were published many times. The Washington "Rules" do not follow exactly the text of these English versions. Here are some of the Washington "Rules," just as he spelled and punctuated them:

Associate yourself with Men of good Quality if you Esteem your own Reputation; for 'tis better to be alone than in bad Company

Wear not your Cloths, foul, unript or Dusty but See they be Brush'd once every day at least and take heed tha[t you approach not to any uncleaness

Be not hasty to believe flying Reports to the Disparag[e]ment of any

Shift not yourself in the Sight of others nor Gnaw your nails

Treat with men at fit Times about Business & Whisper not in the Company of Others

Be not Curious to Know the Affairs tof Others neither approach those that Speak in Private

Eat not in the Streets, nor in yᵉ House, out of Season

Read no Letters, Books, or Papers in Company but when there is a Necessity for the doing of it you must ask leave; come not near the Books or Writings of Another so as to read them unless desired or give your opinion of them unask'd also look not nigh when another is writing a Lettsr.

If You Cough, Sneeze, Sigh, or Yawn, do it not Loud but Privately; and Speak not in your Yawning, but put Your handkercheif or Hand before your face and turn aside.

Do not express Joy before one sick or in pain for that contrary Passion will aggravate his Misery.

Let your Discourse with Men of Business be Short and Comprehensive.

Play not the Peacock, looking every where about you, to See if you be well Deck't, if your Shoes fit well if your Stokings Sit neatly, and Cloths handsomely.

While you are talking, Point not with your Finger at him of Whom you Discourse nor Approach too near him to whom you talk especially to his face

Drink not nor talk with your mouth full neither Gaze about you while you are a Drinking

Let your Recreations be Manfull not Sinfull.

Turn not your Back to others especially in Speaking, Jog not the Table or Desk on which Another reads or writes, lean not upon any one

Keep your Nails clean and Short, also your Hands and Teeth Clean yet without Shewing any great Concern for them

Think before you Speak pronounce not imperfectly nor bring out your Words too hastily but orderly & distinctly

In visiting the Sick, do not Presently play the Physicion if you be not Knowing therein

Be not froward but friendly and courteous; the first to Salute hear and answer & be not Pensive when it's a time to Converse

Undertake not what you cannot Perform but be Carefull to keep your Promise

Speak not Evil of the absent for it is unjust

In Company of your Betters be no[t longer in eating] than they are lay not your Arm but o[nly your hand upon the table].

If others talk at Table be attentive but talk not with Meat in your Mouth

When you Speak of God or his Atributes, let it be Seriously & with Reverence. Honour & Obey your Natural Parents altho they be Poor

MARY WASHINGTON WITH HER FAMOUS AND DEVOTED SON

The early death of his father left Washington to the sole care of his mother, Mary Ball Washington, to whom he was always deeply devoted. We see them above, in a painting by L. E. Fournier, taking the evening air during the mother's last years.

Before he was even 20 he was grown and expert. He could handle rough men; by force when he must, but mostly by patience and the power of his character. Governor Dinwiddie made him a district adjutant of militia with the rank of major, and in October 1753 sent him across the mountains with a message to the French commander at Fort Le Boeuf, to protest against the building of a chain of French forts between Lake Ontario and the falls of the Ohio. Washington delivered the message, and brought back a full report of the French activities. The dangerous journey took ten weeks. Twice Washington nearly lost his life; once an Indian shot at him at a distance of 50 feet, and again he and Christopher Gist, his guide, were thrown off their raft in crossing the Allegheny River.

Colonel of Militia

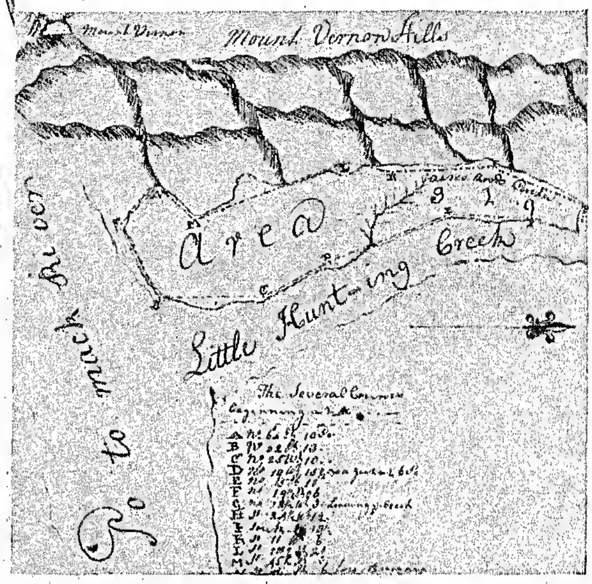
Two months later Washington, now commissioned lieutenant-colonel of Virginia militia, was ordered to proceed immediately with 150 men, all who were then available, to the site of the fort being built at the junction of the Allegheny and Monongahela rivers. Before Washington's small force reached the fort, the French had taken it, and renamed it Fort Duquesne. Washington continued his march, and on May 28, 1754, met and captured a French reconnoitering squad, thus starting the French and Indian War.

Unable to attach any of the Indians to his side, and faced by a greatly superior enemy, Washington then prepared to retire. The Virginians, however, were surrounded in their hastily built works, which they named Fort Necessity, and after a sharp fight were compelled to surrender. Washington had done everything possible with the small force at his command, and he was formally thanked by the House of Burgesses. The next year Washington was once more in the field, as aide to General Braddock, and led back to safety the army which Braddock's ignorance of Indian fighting had almost sacrificed. Out of 1,400 officers and men, only one-fourth came off unharmed. Virginia now authorized the enlistment of a regiment of 1,000 men, and Governor Dinwiddie commissioned Washington as colonel and commander-in-chief of all Virginia forces, a high tribute to the 23-year-old officer. The task was all but impossible—to defend a 350-mile frontier with 1,000 men. Two years later the fall of Fort Duquesne ended the border warfare and Washington's service in the French and Indian War. (*See* French and Indian War.)

Fate made Washington one of the richest men in the colonies. Under the terms of his father's will, the death of Lawrence Washington in 1752, followed in a few weeks by that of his daughter, an only child, gave George, then just 20, control of Mount Vernon, although he did not become the legal owner until the death of Lawrence's widow several years later. In the intervals between campaigns in the French and Indian War, Washington had courted Mrs. Martha Dandridge Custis, a widow with a large estate. They were married on Jan. 6, 1759 (*see* White House). Washington by his marriage became the owner of some 15,000 additional acres, much of it valuable land near Williamsburg.

Through the 15 years after his marriage, Washington was one of the most important and most competent of the Virginia land magnates. He rode his farms, managed their smallest details, was a vestryman in his church, and sat in the House of Burgesses at Williamsburg. There during the sessions, Virginia society gathered, and the Washingtons took a leading place. Tied to the official society that revolved around the royal governor and his officers, Washington also knew intimately the common farmer, and the provincial soldier. He had the confidence of the colonial leaders who were talking resistance to English policy, and his sympathies were with them in their efforts.

THE YOUNG SURVEYOR



The map is a record of a survey of Mount Vernon made by Washington when he was about 14. The original is in the Department of State at Washington.

The Revolutionary Leader

When the coercive acts of Parliament were applied to the New England colonies, Washington offered to equip, and send to Boston at his own expense, 1,000 men to aid Massachusetts. He drilled volunteer companies of Virginia militia, and he rode off, in 1774, with the delegation from Virginia, to attend the First Continental Congress that assembled in Carpenters' Hall in Philadelphia. The next spring, in the Second Continental Congress, Washington appeared in the buff and blue uniform of the Virginia militia. He was not for separation as yet, and hung behind the New England extremists who demanded independence at once. But he believed that the rights of Englishmen in America had been attacked, and was ready to fight for their maintenance. As this Congress considered the news of Concord and Lexington, and of Gage's English army hemmed in at Boston by the New England farmer troops, it became clear that there must be resistance on a continental scale. On motion of John Adams, the command of the new Continental Army was given to Colonel Washington of Virginia, who asked no pay beyond his actual expenses, saying that "as no pecuniary consideration could have tempted me to accept this arduous employment at the expense of my domestic ease and happiness, I do not wish to make any profit from it." He went at once to Cambridge, and there, in June 1775, took command of the Continental Army.

For the next six years, his character was a powerful force in holding the 13 colonies to their common purpose until success was reached. Though Congress was a shifting revolutionary body that had no legal authority until after the adoption of the Articles of Confederation in 1781, and the poverty-stricken states were jealous and divided, George Washington remained, through failure and success, the constant foundation of patriotic devotion and sacrifice. (*See* Articles of Confederation; Revolution, American.)

Independence Won

The task of Washington in these years was more than that of a general who directs a battle. He must first make his army—from untrained and often unpaid men. The officers were jealous and forever quarreling; and Congress often gave them cause for grievance by promoting foreign soldiers to high rank. For example, it made Lafayette a major-general at 20; which was a wiser act than anyone had a right to expect, for Lafayette proved to be both a good general and a symbol of the aid from France.

Washington never had an army large enough to risk pitched battles. A century later von Moltke, a great German tactician, said of him that "he seldom won a battle but he never lost a campaign."

Washington's plan was always to make it costly for the English forces to hold the regions in which their armies were. He forced them, in turn, out of Boston and out of Philadelphia, and penned them up in useless occupation of New York. When in 1781 the right moment came, with a French army and a French fleet to coöperate, he invested Cornwallis in the peninsula at Yorktown and forced the surrender of his army.

The fighting was over in 1781, but the Continental Army was held together for two years more until the final peace was ratified. Some of its hotheads, angry over slow pay and an ungrateful Congress, talked mutiny and seizure of the government. But always Washington stood in the way, patient and moderate,

as eager now to disband the forces and return to peace as he had been determined not to give up until victory was won. He bade his soldiers farewell in 1783, and returned to Mount Vernon.

"Let Us Raise A Standard"

The next six years were the "critical period" in American history, for it remained to be seen whether the states, having gained independence, could build a peaceful and prosperous society. The public life of Washington seemed to be over, and as a private citizen he took his part in the work. His wisdom as farmer and business man soon became evident. Throughout his eight-year absence from Mount Vernon, during the war, he required written reports from the manager of his estates, and in reply sent detailed instructions as to what should be done. Apparently he inherited from his English ancestors a love for the land, and the ownership of land came to be for him a symbol of advancement in life. When he decided to have a book plate he added to his family crest some spears of wheat, to indicate "the most favorite amusement of my life," as he put it.

Washington was one of the first American agriculturists, and was in correspondence with Arthur Young and other experimenters both at home and abroad. He imported plants, shrubs, and trees from all parts of the world. He experimented with alfalfa as early as 1760, and with Thomas Jefferson was one of the first to set out pecan trees. He tried clover, rye, and timothy as crops to enrich the soil. He was an early convert to rotation of crops even in a time when new land was still freely available. He is thought to have been the first farmer in America to try raising mules, and he improved his breed of sheep so that he obtained more than double the average yield of wool. He steadily added to the Mount Vernon estate until it totaled 8,000 acres, divided into five farms. He complained of heavy losses in bad years, but in good years his profits were as high as $15,000.

Not content to improve the group of farms that he had assembled, he looked to further improvements in the West. Never could he forget the Ohio country in which he showed his mettle as a young man. He visited it again, and foresaw the great procession of farmers that was soon to bring into existence Kentucky, Tennessee, and Ohio. He himself acquired over 50,000 acres, scattered over seven states. The Potomac River appeared to be destined to become the great highway of emigration and trade, and Washington took active part in a company to improve its navigation and promote its use.

Out of the need for coöperation in improving navigation, among the states concerned—Virginia, Maryland, and Pennsylvania—the discussions started that turned the critical period towards success. Washington was a leader at every stage in the movement that brought together in Philadelphia in May 1787, a federal convention to consider the revision of the Articles of Confederation (*see* United States Constitution). He presided over the long deliberations behind closed doors, and he gave full support, though as usual with few words, to the building of the new structure when it became certain that the old Articles could not be successfully revised. "It is too probable that no plan we propose will be adopted," he is reported to have declared. "Perhaps another dreadful conflict is to be sustained. If, to please the public, we offer what we ourselves disapprove, how can we afterwards defend our work? Let us raise a standard to which the wise and honest can repair. The event is in the hand of God."

WASHINGTON, THE PEACEFUL COUNTRY GENTLEMAN

Washington wrote to Arthur Young in 1788, "How much more delightful to an undebauched mind is the task of making improvements on the earth than all the vain glory which can be acquired from ravaging it, by the most uninterrupted career of conquests."

After the Constitution was adopted, Washington was the obvious man for president. On April 6, 1789, the electoral vote for president was made known. Washington was unanimously chosen, having received 69 votes, the total number of votes cast. John Adams was elected vice-president. Washington had already shown himself to be a great man of affairs, a great general, and a great citizen. He was now to prove that he could also be a great statesman.

WASHINGTON'S ADMINISTRATIONS (1789–1797)

Federal Executive Departments and Judiciary System organized.
North Carolina ratifies Constitution (1789), Rhode Island (1790).
Mint established at Philadelphia and System of Coinage adopted.
National Debt funded and State Debts assumed by National Government.
Site on Potomac chosen for National Capital.
First Federal Census; Population, 3,929,214 (1790).
Indian War in Northwest Territory (1790–95).
First National Bank chartered (1791).
First Ten Amendments ("Bill of Rights") adopted (1791).
Vermont admitted (1791), Kentucky (1792), Tennessee (1796).
Republican (later Democratic) and Federalist Parties appear.
Washington and Adams reëlected (1792).
Eli Whitney invents Cotton Gin (1793).
Washington issues Neutrality Proclamation (1793).
"Whiskey Rebellion" in Pennsylvania suppressed.
"Jay's Treaty" of Amity, Commerce, and Navigation concluded with Great Britain (1794).
Washington's Farewell Address (1796).

Washington the President

Never before had there been a government quite like that which Washington was called upon to organize in 1789. The 13 states had tested dependence under England and wanted no more of it. They had been, in fact, independent republics during the Revolution. No one knew exactly what the new Constitution meant, or how far in practise it would limit the independence of the states. Washington was determined to make out of the United States a real government, and selected as his advisers some of the best men available—Jefferson, Hamilton, General Knox, and Edmund Randolph.

The new government was launched on April 30, 1789, when Washington took the oath as president in New York. His trip to the seat of government from his Virginia home was a stately procession. Always a man of great personal dignity, he now required added ceremony to make it clear that his office was important. In the children's parties at the president's house he could unbend, and any child could understand him; but to men and women he was the president; and to those who disobeyed his orders or disregarded their trusts he could display a terrible and consuming temper. But all felt he was their fellow citizen.

"To Lay and Collect Taxes"

The government under the Articles of Confederation had broken down, largely because it could neither lay nor collect a tax. But the new Constitution gave to Congress this power. At once a customs duty, or tariff, was laid upon imports, and a direct tax was levied against certain kinds of property within the United States. Money soon made its appearance in the treasury, and bills began to be paid. Congress even agreed to assume the debts incurred during the Revolution by the individual states (*see* Hamilton, Alexander). A site was chosen on the left bank of the Potomac, a little above Mount Vernon, to be the capital city of the new republic. Until the buildings there were ready, the government stayed for a year in New York, then for ten years in Philadelphia. Washington did not live to see his dream of the federal city realized, but he helped to select its site and to direct the preliminary work upon it (*see* Washington, D. C.).

Western Neighbors

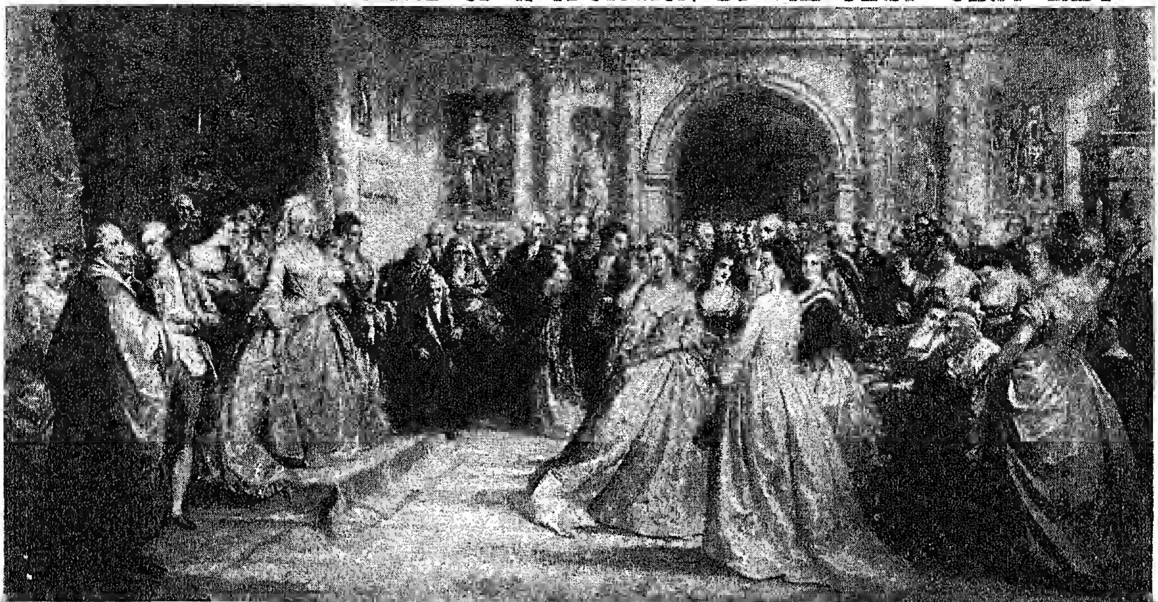
England still held the trading posts and forts along the southern side of the Great Lakes, which the peace treaty gave to the United States. Her Canadian subjects wanted to retain these lands for the fur trade; and since the states made it difficult or impossible for the Tories to regain their confiscated property in the United States she held the country as a measure of retaliation.

In the southwest, Spain held parts of Mississippi, Alabama, and Tennessee. England had given the United States the east bank of the Mississippi River as far south as the bluff of Natchez (the 31st parallel) without consulting Spain; whereas Spain claimed to own, either as part of Florida or by conquest from England, most of the country south of the Tennessee River. Meanwhile Washington had been reëlected president (1792) by an electoral vote of 132 to 77 for John Adams. Still the foreign neighbors held soil of the United States, and in 1794 there were rumors of approaching war with England and with Spain. A special minister, John Jay (*see* Jay, John), was hurried to London to make a treaty of commerce, and to settle the boundary disputes. England agreed to surrender Niagara, Detroit, Mackinac Island, and the other places which she had held. Another special minister, Thomas Pinckney, went to Madrid, and in 1795 secured from Spain an agreement to respect the 31st parallel as the boundary between Florida and the United States. With the boundary issues adjusted, Washington had made the United States master in its own house.

Peace with the Indians

But that mastery was by no means settled so long as the Indian tribes were unaware of it, or until its own citizens had been taught to respect it. Even before the Constitution was adopted, the Congress

THE DIGNITY AND ELEGANCE OF A RECEPTION BY THE FIRST "FIRST LADY"



As wife of the President, Martha Washington entertained with 18th-century prim elegance. This scene, by Daniel Huntington, shows Mrs. John Adams, extreme left; Chief Justice John Jay in judge's robes; Nellie Custis and Mrs. Robert Morris at Martha Washington's left; center, with fan, Mrs. John Jay. The original, in the Brooklyn Museum, is owned by the Hamilton Club.

had organized the country beyond the Ohio as the Northwest Territory. Settlers crept in, below Pittsburgh, and soon had a chain of villages down to Cincinnati; their farms pushed up the Muskingum, the Scioto, and the Miami.

On the border there was always war. To the Indian, the progress of settlements meant extinction, for wild game disappeared before the advance of the frontier farmer. In 1791, and again in 1792, military expeditions were sent from Cincinnati, where Fort Washington was the army headquarters, to visit the tribal villages along the Maumee River. Both times the little armies were surprised and routed.

After the second defeat, Washington placed Gen. Anthony Wayne in charge of the American legion which was to enforce a peace (*see* Wayne, Gen. Anthony). In 1792 Wayne recruited his army. In 1793 he trained it, and began to erect a chain of forts from Cincinnati north towards the Maumee. In 1794 he built Fort Defiance under the eyes of the English at Toledo Bay, and before the year was over he defeated the Indians at Fallen Timbers. Never again was Ohio in danger, and the occupation of the West proceeded with quickened pace. On the southern border, in Georgia and Tennessee, steps were taken to quiet the Cherokee and Creek Indians. The admission of Kentucky as a state in 1792, and Tennessee in 1796, stiffened the defenses of the pioneers.

The Whiskey Rebellion

Yet the pioneers were a lawless lot, and had been restive under the control of any government ever since they were enraged by England's Proclamation of 1763 (*see* Revolution, American). The financial measures of Washington's government made them angry. One of the new taxes was levied upon the stills with which whiskey was made. Every frontier farmer had one. There was no home market for the western grain, and freight was too costly for it to be hauled long distances. When it was distilled into whiskey its value was raised and its bulk decreased. The tax on stills was a special grievance, and seemed to hit an essential industry. So the farmers in western Pennsylvania, in the summer of 1794, refused to pay the tax, and harassed the collectors as the eastern colonists had, twenty years before, hazed the collectors of England's Stamp Tax. The money was not important, but the principle was vital, if the United States was to exercise its powers. As the "whiskey rebellion" became acute, Washington called out the militia of the near-by states, 10,000 strong, and marched them to Pittsburgh to arrest the leaders of the conspiracy. Such enforcement was unpopular in the West, and helped turn the Westerners toward the new Democratic-Republican party of Jefferson. But it established once and for all the power of the new republic to raise money by taxation.

Peace and Neutrality

While in every direction Washington was building a strong government, there came in 1793 a general war in Europe that threatened to engulf it. France had gone through its Revolution, and had executed Louis XVI and Queen Marie Antoinette. It believed that England was fighting to upset its Revolution; England thought France was fighting to spread revolution everywhere. The United States was bound to France by a debt of gratitude and by a promise to help her if she were attacked by her enemies. But the young republic was in no condition for another

war, and to Washington it seemed that France had herself provoked the struggle. The situation was made more complicated by the conduct of the new French minister, Citizen Genêt, who was seeking recruiting agents and commissioning privateers. With the unanimous approval of his cabinet, two weeks after Genêt's arrival in April 1793, Washington proclaimed the neutrality of the United States, refusing to aid either France or England, and asserting the right to continue to trade freely with both. In spite of protests from Jefferson, then secretary of state, Genêt continued to fit out privateers, which captured about 50 English merchantmen, some of them in American waters. Genêt declared that the Constitution did not give Washington the right to interfere with him. His behavior was so objectionable that the French government recalled him early the next year.

The Genêt affair caused a great public clamor, and it was also one of the factors which led to the resignation of Jefferson from the cabinet and to the clear division between the Federalists and the Democratic-Republicans. For many years, until after 1815, when Napoleon Bonaparte was carried a prisoner to St. Helena, the United States was never free from troubles due to the war in Europe. Washington's successors, however, attempted to maintain his ideal of neutrality, and for a century non-interference in Europe's quarrels was a cardinal principle of American policy. Washington's words in his Farewell Address, warning the American people against "entangling alliances," have never been forgotten.

The Memory of Washington

It was a great thing for Washington to have saved the Revolution and to have achieved independence for the United States. It was great, too, for him willingly to surrender military power and to become again a private citizen. But it was even greater to construct the framework of a new nation, and in eight years to clothe the words of its Constitution with reality. Today this greatness is remembered. But for Washington the last years in office were years saddened by political opposition to his policies that sometimes took the form of personal attacks. Washington sometimes feared that the peace of the country would be wrecked in civil war. He could not understand why all honest men could not agree. Near the end of his second term he wrote to Jefferson, then a bitter opponent of his foreign policy, that he had not believed until lately that he could be "accused of being the enemy of one nation and subject to the influence of another; and to prove it, that every act of my administration would be tortured, and the grossest and most insidious misrepresentations of them be made, by giving one side only of a subject, and that too in such exaggerated and indecent terms as could scarcely be applied to a Nero, a notorious defaulter, or even to a common pickpocket."

In spite of all opposition, he might have been reëlected to succeed himself for a third term, but he was weary. He thought, too, that it would be unwise for any one man to hold power for too long a time. By refusing a third nomination he established a tradition which endured for many years in American history. And by refusing he gained 33 months in which to enjoy the country life that he loved so much.

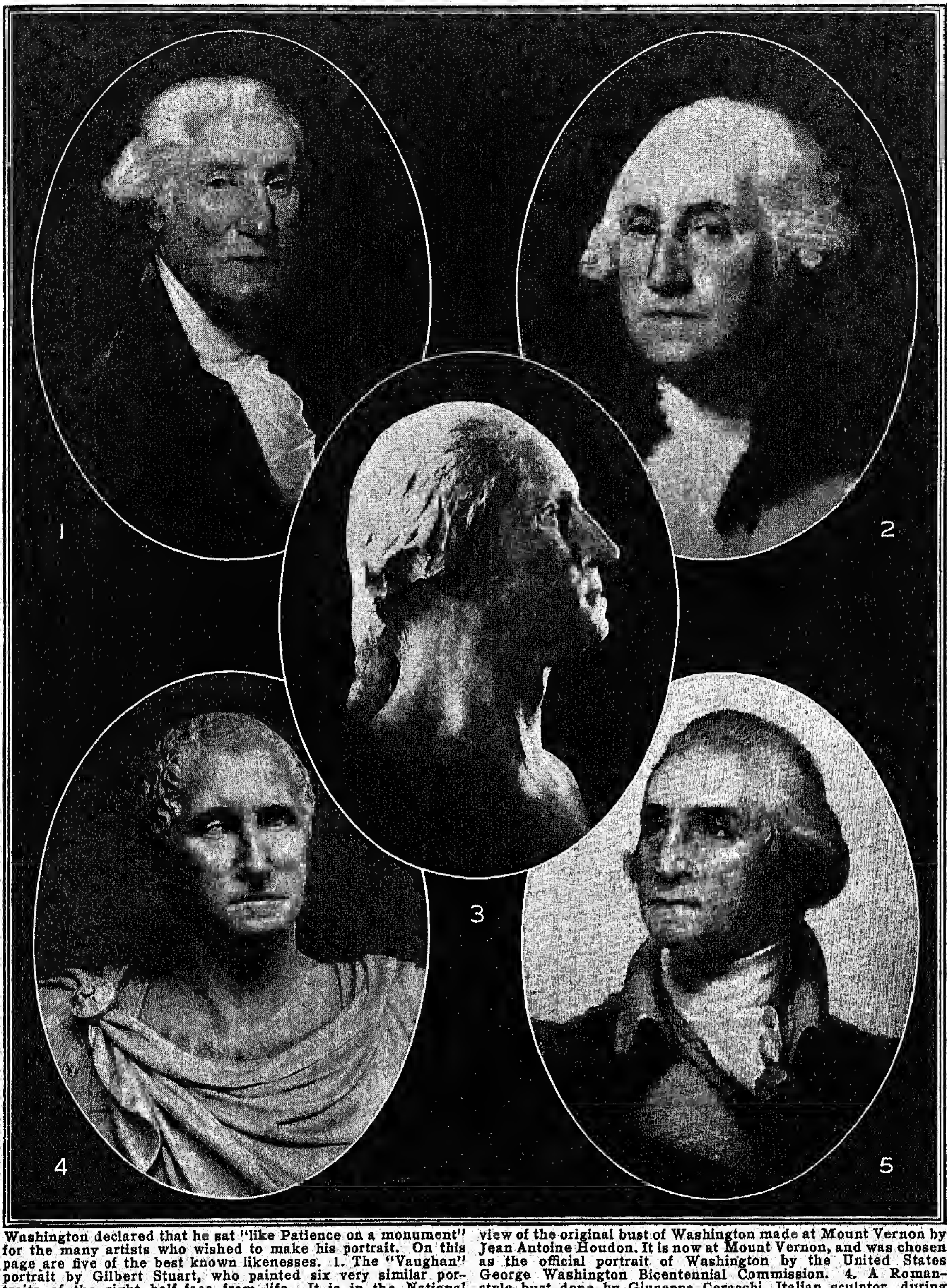
"Much such a day as yesterday in all respects. Mercury at 41." That is the whole entry in Washington's diary for March 4, 1797, the day he turned over the administration to his successor. John Adams, writing next day to his wife, tells the story better: "A solemn scene it was indeed, and it was made affecting to me by the presence of the General, whose countenance was serene and unclouded as the day. He seemed to me to enjoy a triumph over me. Methought I heard him say, 'Ay, I am fairly out and you fairly in! See which one of us will be happiest!' When the ceremony was over, he came and made me a visit, and cordially congratulated me, and wished my administration might be happy, successful, and honorable.... In the chamber of the House of Representatives was a multitude as great as the space could contain, and I believe scarcely a dry eye but Washington's."

Life at Mount Vernon

The last months at Mount Vernon were busy and happy, though saddened by the deaths of his sister Betty, and of Charles, the last of his brothers. The management of his estates took a great deal of time and energy. He had other business responsibilities. He was a director of the bank at Alexandria, and an officer or director in various land companies. Mount Vernon, too, was a place of pilgrimage, for friends and strangers of all degrees. Washington's diary during these months is largely a record of dinner and house guests. George Washington Lafayette, son of the Marquis, was his guest for the first six months after the return to Mount Vernon. A young lady who visited them at this time wrote that "they live in great style and with the utmost regularity. Breakfast is on the table at seven o'clock, dinner at three, tea at seven, and supper at nine. The President employs his mornings in riding over the farm. He is one of the most charming men in the world, always in good spirits, and makes it his chief duty to render all around him as happy as possible."

On Dec. 12, 1799, the General rode over his farms for five hours. It was snowing when he started out, but later changed to hail and a cold rain. His hair and neck-cloth were wet when he returned, but he sat down to dinner, which had been waiting for him, without changing his clothes. The next day he complained of a sore throat. During the night of the 13th he felt seriously ill, but he would not allow Mrs. Washington to get up or disturb the household lest she should catch cold. All through the 14th he grew steadily weaker, in spite of bleeding, hot applications, and other simple remedies which were tried. At 20 minutes past ten that night, Saturday, December 14, he died. In accordance with his wishes Washington was buried in the small family vault on the hillside at Mount Vernon, overlooking the Potomac River. John

WASHINGTON AS DIFFERENT ARTISTS SAW HIM



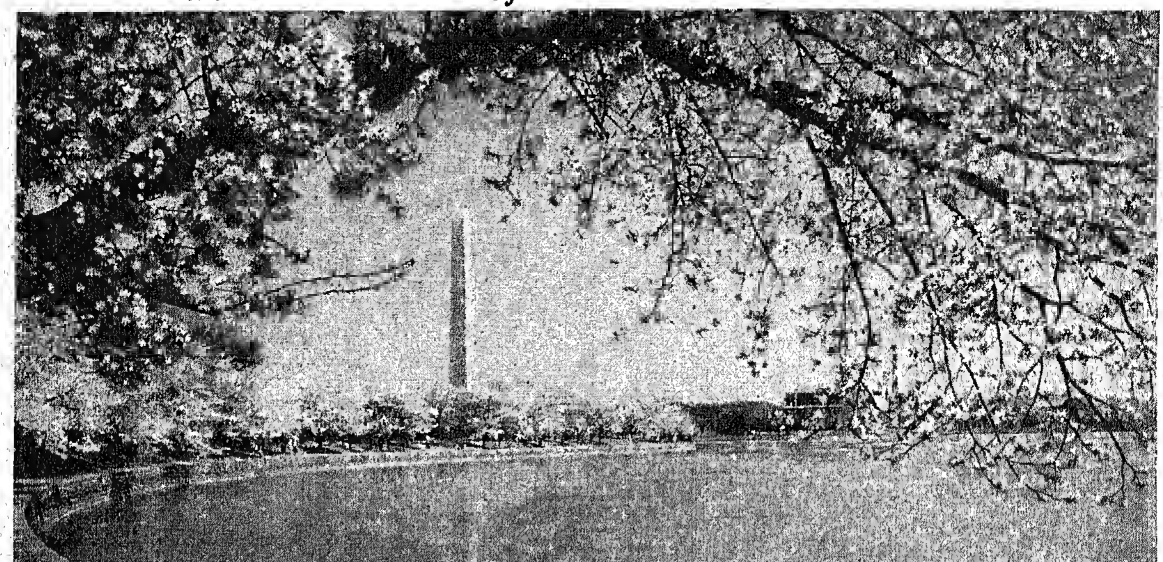
Washington declared that he sat "like Patience on a monument" for the many artists who wished to make his portrait. On this page are five of the best known likenesses. 1. The "Vaughan" portrait by Gilbert Stuart, who painted six very similar portraits of the right half-face from life. It is in the National Gallery of Art in Washington, D. C. 2. Stuart's famous "Athenaeum" portrait, unfinished, showing the left half-face. It was painted about 1796 and is now in the Boston Museum. 3. A side view of the original bust of Washington made at Mount Vernon by Jean Antoine Houdon. It is now at Mount Vernon, and was chosen as the official portrait of Washington by the United States George Washington Bicentennial Commission. 4. A Roman-style bust done by Giuseppe Ceracchi, Italian sculptor, during a visit to America in 1795. It is in the Metropolitan Museum of Art, New York City. 5. One of Rembrandt Peale's portraits in the New York Historical Society Art Gallery, New York City.

Marshall, then a member of Congress, in moving the resolution of national grief, quoted the words of Henry Lee which truly sum up Washington's place in American history: "First in war, first in peace, first in the hearts of his countrymen." Perhaps the final word on Washington was said by John Richard Green, the historian, when he characterized Washington as "the noblest figure that ever stood in the forefront of a nation's life."

George and Martha Washington had no children. Mrs. Washington had two children by her first husband, Jackey and Patsey (Martha) Custis, who came to live at Mount Vernon. Patsey's death in childhood was a great blow. Jack Custis accompanied his stepfather during many campaigns in the Revolution, and died of a fever during the siege of Yorktown. Jack's two younger children, Eleanor Parke Custis, aged three, and George Washington Parke Custis, a baby of a few months, were adopted by the General and Mrs. Washington as their own. They grew up at Mount Vernon surrounded by love and care which could not have been greater if they had been the General's own children. Eleanor seems to have been his favorite, and to have returned his affection. She always addressed him as "grandpa," but spoke of him to others as "Farmer Washington." She paid him the high compliment of being married on his birthday, 1799; her husband, Lawrence Lewis, was one of Washington's favorite nephews.

Standard biographies of Washington are those by Worthington C. Ford, Henry C. Lodge, Woodrow Wilson, and Bernard Faÿ. A heroic picture of Washington is given in 'Valley Forge', a three-act play by Maxwell Anderson. Suitable for young readers are: 'The True Story of George Washington' by E. S. Brooks (grades 4–6); 'On the Trail of Washington' by F. T. Hill (grades 6–8); 'George Washington' by Horace E. Scudder (grades 7–8); 'The Boy's Life of Washington' by Helen Nicolay (high school); 'Seven Ages of Washington' by Owen Wister (high school). 'George Washington Plays', by Anne P. Sanford, is a volume of short plays for children of varying ages. 'The Unknown Washington', by John Corbin, criticizes many standard histories.

The CAPITAL *of the* UNITED STATES



"Build it to the skies; you can not outreach the loftiness of his principles!" exclaimed Robert C. Winthrop in laying the cornerstone of the Washington Monument on July 4, 1848. How well the builders heeded his words may be judged from the way the Monument dominates this scene, as we look across the Tidal Basin of Potomac Park. The Monument is equally dominating in almost any view. The lovely Japanese cherry trees which frame this scene were given by the mayor and the council of Tokyo in 1912. Such mingling of natural beauty with imposing works of man is typical of Washington.

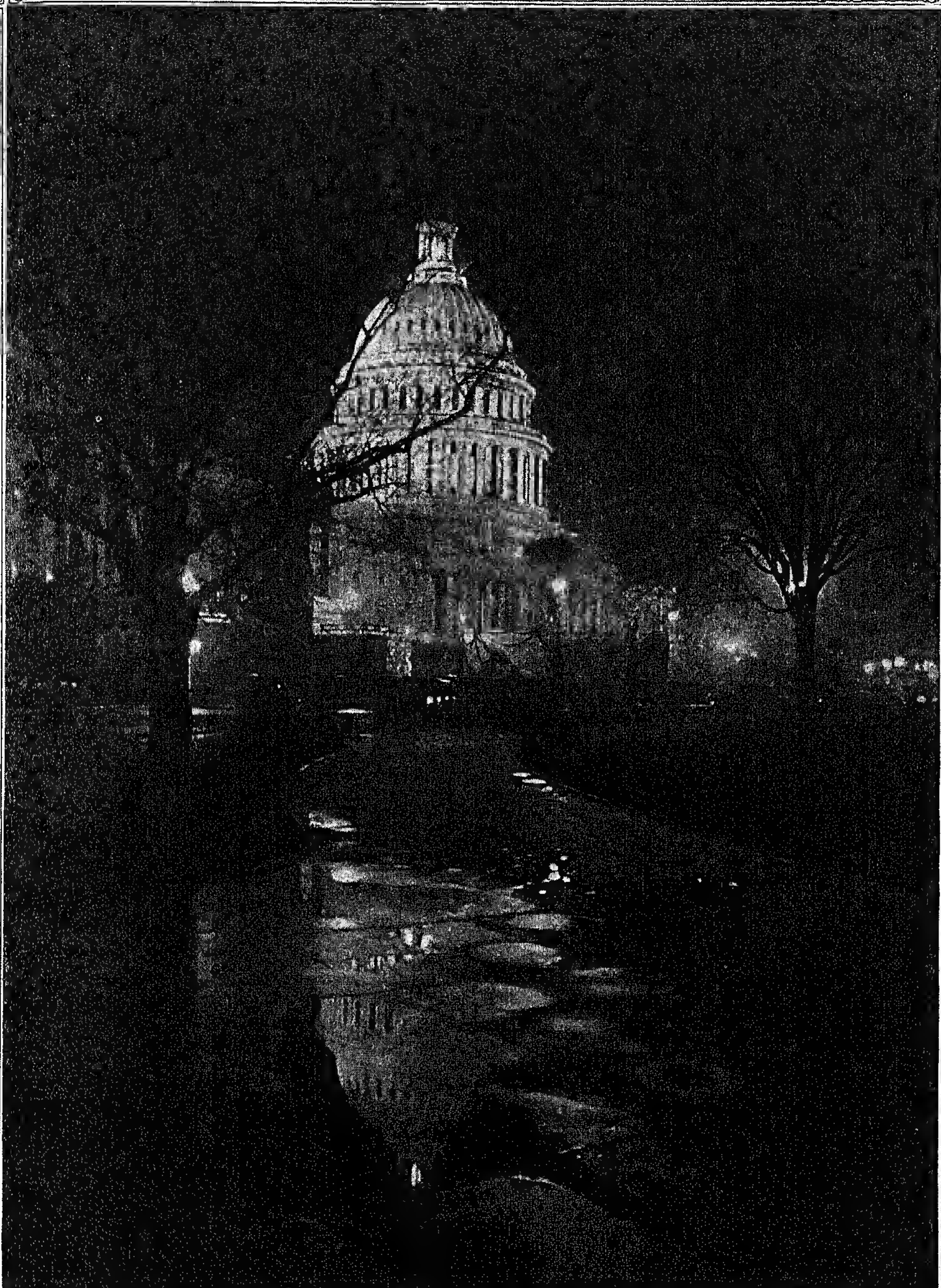
WASHINGTON, D. C. On March 30, 1791, a group of six men, bundled in greatcoats, could be seen riding over a "wilderness" on the Potomac River. The leader was President Washington, who was to approve the site selected for a new capital city, authorized by the Constitution.

A political bargain, resulting in an act of Congress approved July 16, 1790, had fixed the general location. The Northern states, which had wanted the new city located on the Delaware River, consented to a site on the Potomac, in return for Southern votes to have the national government pay the debts incurred by the states during the Revolutionary War. Maryland and Virginia had promised land.

When Washington had approved the site, Maj. Pierre Charles L'Enfant, a French engineer who had fought in the American Revolution, prepared the plans (for map *see* Maryland). The cornerstone of the Capitol was laid Sept. 18, 1793, and the government moved to Washington in 1800.

The Capitol, "heart of the nation," lies 751 feet wide in a park at the center of the city. Crowned

THE UNITED STATES CAPITOL AT NIGHT



The magnificent Capitol at Washington, always so impressive in its majesty and beauty, is never more striking than when seen at night brilliantly illuminated, as it is here. With its immense dome, its stately columns, and the noble dignity of its style and proportions, it forms a fitting symbol of the nation's greatness.

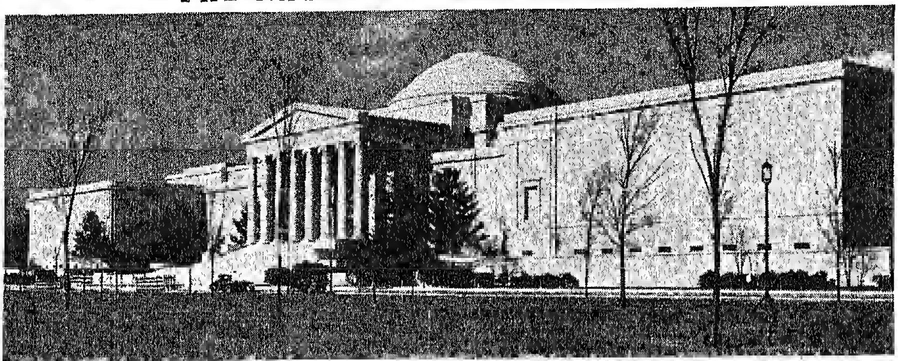
by an immense dome on which stands a statue of Freedom rearing its helmeted head 304 feet above the ground, this is one of the most imposing buildings in the world. As one approaches it from the east, great flights of steps seem to flow from beneath the huge columns that mark its three giant porticoes. In the wing to the left is the House of Representatives; in the wing at the right is the Senate. From the portico in the center two big bronze doors, with panels illustrating the life of Christopher Columbus, swing back and lead into the rotunda 96 feet in diameter, from which you gaze up 183 feet into the dome. Its walls are decorated with paintings and statues representing important scenes and figures in American history.

South of the rotunda is the semicircular National Statuary Hall. Here each state may honor two of its citizens with statues. The hall was used by the House of Representatives before the present House wing was added at the south in 1851–57.

North of the rotunda is another semicircular chamber. This served the Senate until 1859, when that body moved to the wing built for it at the north. The Supreme Court then used the chamber until 1935.

As you ascend the spiral staircase to the crowning cupola of the great dome, Washington spreads out before you in impressive panorama. What at first appears to be a maze of crisscross thoroughfares stands out suddenly in orderly arrangement. You see that the general plan is composed of streets running at right angles to each other, and that these are intersected by broad avenues, sweeping diagonally from one corner of the city to the other. The principal streets converge like the spokes of a wheel below you at the Capitol grounds. Farther out are other focal centers. The intersections of these great tree-lined avenues are marked by small parks.

THE NATIONAL GALLERY OF ART

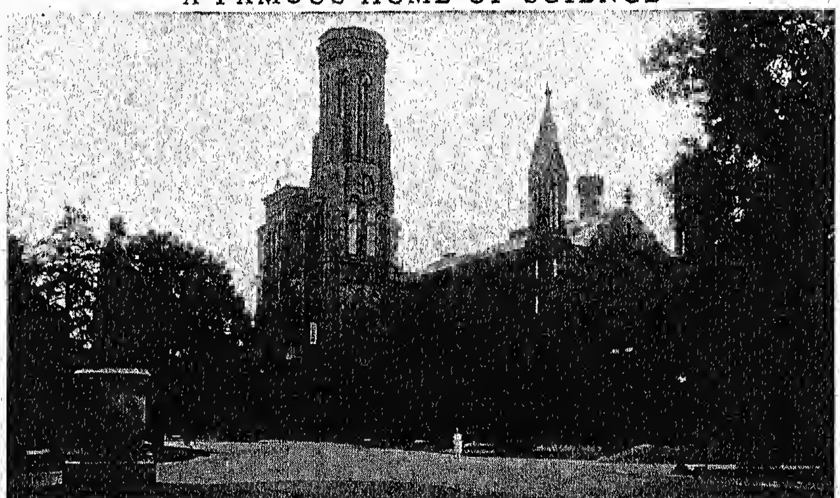


This great building, 785 feet long, on Constitution Avenue was opened in 1941. Designed by John Russell Pope, it is built of brick and concrete faced with rose-white Tennessee marble. Andrew Mellon gave his famous collection to form the nucleus of the Gallery and other donors followed suit. Outstanding among its masterpieces are the paintings called the 'Alba Madonna' by Raphael and the 'Adoration of the Shepherds' by Giorgione.

Grouped about the Capitol grounds are many important buildings, including the Union Station and office buildings for congressmen. East of the grounds is the huge building, in Grecian temple style, which has housed the Supreme Court since October 1935. Farther east and a little south is the Folger Shakespeare Library, opened in 1932; it houses a valuable collection of books and Elizabethan relics.

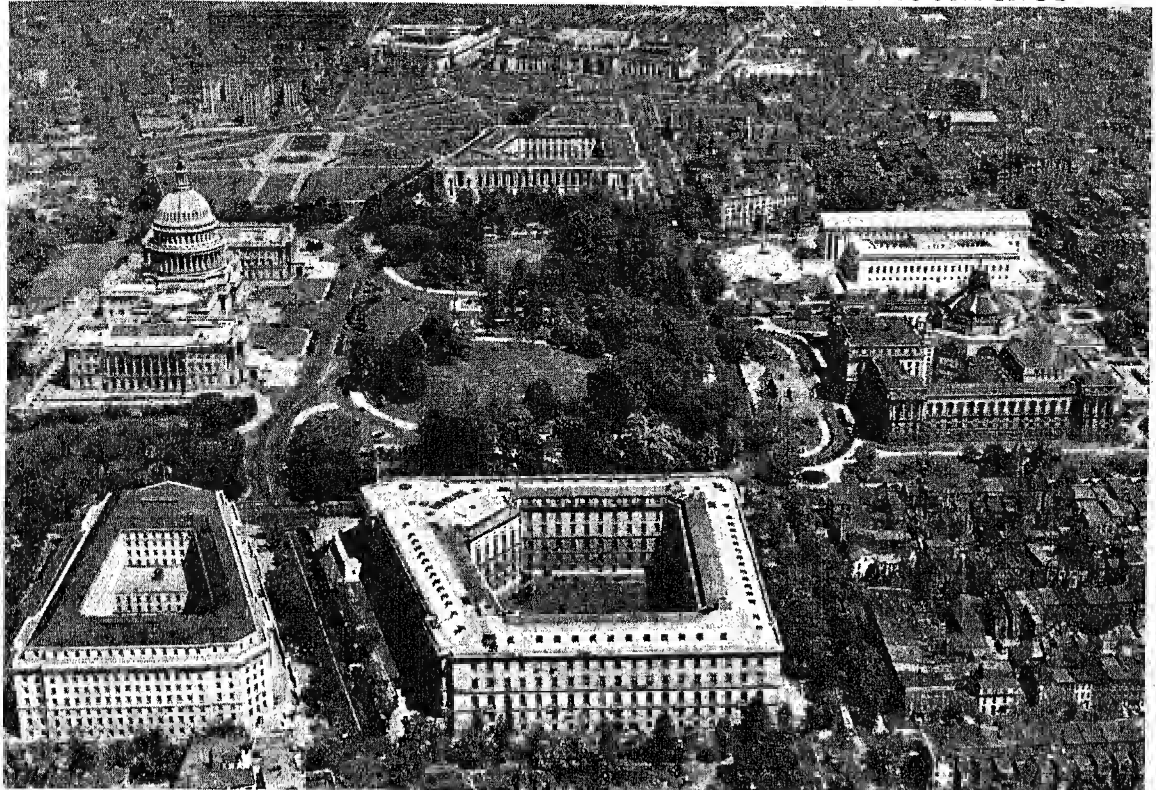
To the southeast stands the Library of Congress, completed in 1897. Two copies of every book or pamphlet copyrighted under the laws of the United States must be deposited free in the Library of Congress, and here also are gathered books by purchase from all over the world and some of the nation's most important historical documents. The walls and ceilings are splendidly decorated with mural paintings, all by eminent American artists, representing the arts, sciences, history and mythology, and the march of civilization. Bas-reliefs on the three great bronze

A FAMOUS HOME OF SCIENCE



This is the famous Smithsonian Institution, founded under a bequest of James Smithson "for the increase and diffusion of knowledge among men." The statue in front is of Joseph Henry, the first secretary of the Institution.

LOOKING NORTH OVER THE CAPITOL AND ITS SURROUNDINGS



This airplane view looks north across Capitol Park at the east end of the Mall. The Capitol is in the middle left. In the foreground are the two House of Representatives Office Buildings. The Senate Office Building is at the farther edge of Capitol Park. On the eastern (right-hand) edge of the park are the Library of Congress with its low dome and, beyond, the home of the Supreme Court, opened in October 1935. The building with the barrel roof in the middle background is the Union Station. Trains from the west, north, and northeast enter it directly; those from the south come through a tunnel under Capitol Hill. Left of the station is the City Postoffice, and beyond that, the dark bulk of the Government Printing Office.

doors by Olin Warner and Frederick MacMonnies symbolize Tradition, Writing, and Printing. (For interior view, *see* Libraries.)

The best view of Washington, however, is obtained by looking west from the cupola. West to Potomac Park and the river runs the parked strip called the Mall, flanked by government buildings.

Somewhat to the northwest runs Pennsylvania Avenue, once the principal street of the city. It is broken into, over a mile away, by the Treasury Building. This structure, flanked with columns like a Greek temple, houses the department which controls the financial affairs of the government.

The "Triangle" of Departmental Buildings

Between the Mall and Pennsylvania Avenue is a triangular strip, completely covered with buildings housing executive departments of the government. Near the Capitol end is the Archives Building, sealed against outside air and designed to preserve government records for all time. Beyond are buildings for the Department of Justice, the Bureau of Internal Revenue, the Postoffice Department, the Interstate Commerce Commission, the Department of Labor, and the Department of Commerce. Nearly all the structures in "the Triangle" have been built as part of the plan developed by the National Capital Park Commission established in 1924.

The White House and Its Neighbors

Just west of the Treasury is the White House, home of the presidents; it is formally called the Executive Mansion (*see* White House). The south lawn, where children enjoy egg-rolling on Easter Monday, becomes a broad park leading to the Washington Monument. West of the park is a group of notable buildings, among the finest in Washington. Here are the Corcoran Gallery of Art with its fine collection; the Red Cross Building, the American headquarters of that organization; Continental Hall, erected by the Daughters of the American Revolution and other patriotic societies; and the Pan-American Union, established to foster friendship among the 21 American republics.

To the north of the White House is Lafayette Park, beautiful with trees and flowers, and the home of the Veterans' Bureau. To the west is the four-and-a-half-acre, five-story building which is occupied by the State Department. The Navy Department, housed here until the first World War, now occupies a structure in the north end of Potomac Park. The Interior Department Building, the Naval Hospital, and the National Academy of Sciences are near by.

More impressive even than the view down Pennsylvania Avenue is the vista westward from the Capitol down the broad green stretches of the Mall. This is a park, the width of four blocks, which extends to the banks of the Potomac and in which are an imposing array of public buildings—the National Museum, Smithsonian Institution, the Department of Agriculture, etc. In the distance rises the great white shaft of the Washington monument, 555 feet high. This was begun in 1848 and completed in 1884 at a cost of more than a million dollars. An elevator and an iron stairway of 900 steps lead up to the apex, which is capped with an aluminum point.

The Smithsonian Institution and the old and new National Museums form a center of scientific knowledge in the United States. The first of these is named from James Smithson, an Englishman who in 1829 bequeathed his fortune to the United States to be devoted to "the increase and diffusion of knowledge among men." Accordingly the Smithsonian Institution, established by Congress in 1846, undertakes to encourage research, supervise trips of exploration, conduct investigations in natural history, geology, ethnology, archaeology, and other scientific subjects, gather and classify rare and interesting specimens, and publish reports of discoveries. Its immense collections of plants and animals, of minerals, of historical documents and relics, etc., are housed in the two museum buildings, which are under the direction of the board of regents of the institution.

On the Mall are two great art museums. The Freer Gallery of Art is notable for its collection of the works of James A. McNeill Whistler and for its Asiatic treasures. The National Gallery of Art houses one of the world's finest collections of Italian masterpieces, given to the nation by Andrew W. Mellon and by Samuel H. Kress.

Potomac Park and the Lincoln Memorial

Looking southwest from the Capitol, the eye meets the long sweep of Potomac Park, which stretches along the river for more than two miles. A tidal reservoir with a bathing beach lies midway in the park, while its southeastern part is an island separated from the mainland by the Washington channel, with its long lines of docks and piers. At the upper end of Potomac Park stands the Lincoln Memorial, a great building in the form of a Greek temple with white marble columns 40 feet high (for picture *see* Lincoln). In Potomac Park and near by were located many of the vast numbers of emergency buildings that were constructed during the first World War to house the overflow of the war-working department of the government. Although most of these were intended to be only temporary, the Navy Department, toward the foot of 17th Street, was given a permanent fireproof structure with the plain practical lines of a modern office building.

On the edge of Potomac Park, southeast of the Washington Monument, is the Bureau of Engraving and Printing, where paper money, government bonds, postage and revenue stamps, etc., are printed. The public is allowed to see all the operations except the actual engraving of the plates, which is done in secret for fear of encouraging counterfeiting. The government printing office, in which are printed the *Congressional Record* and other publications produced from type, is on North Capitol Street in another quarter of the city.

The College of the Art of War

South of the Capitol, at the point where the Anacostia River flows into the Potomac, is Fort Humphreys, one of the oldest army posts in the United States. At its southern end is the Army War College, where officers who have distinguished themselves in the service attend classes in advanced military science. About a mile up the Anacostia River is the big United States Navy Yard, where great lathes turn out monster guns for warships. Here also cannon captured in the various American wars are on exhibit. A willow tree which shades the naval museum here was grown from a slip taken from a tree over Napoleon's old grave on the island of St. Helena.

One of the most striking sights looking north from the Capitol cupola is the immense bulk of the Union Station, opened in 1908 at a cost of four million dollars. It is built of Vermont granite in a series of great arches and vaults. The passenger concourse is said to be the largest room in the world under one roof; 50,000 men could stand there.

On 10th Street in the northwest section is the old Ford's Theater building, in which Lincoln was shot. Across the way is the house in which he died. The theater has been converted into a museum. The General Land Office, the Pension Office, and the City Hall are in this quarter. The city postoffice, built of white marble, is near the Union Station.

Many Sights in Georgetown

Gazing out toward the city limits, you see in the northwest the heights of Georgetown, beyond Rock Creek. This former suburb was founded before Washington itself, but today it forms a part of the city; it was named for George II. It is the seat of Georgetown University, the oldest Jesuit college in the United States, founded in 1789.

On a height north of Georgetown stands the United States Naval Observatory. Through its great telescope are made the observations which regulate official time for most of the country. A short distance up the Potomac from Georgetown are the Falls, which mark the head of navigation on the river. In older days the Chesapeake and Ohio Canal carried traffic as far as Cumberland, Md. Steamers connect Washington with Mount Vernon, Norfolk, and Baltimore.

In the valley of Rock Creek, lying between Georgetown and the rest of Washington, is the Zoölogical Garden. A park beyond extends to the district limits. East of the zoo and north of the Capitol, the United States Soldiers' Home stands in immense grounds. It was founded in 1851 and is open to soldiers who have served 20 years or more, or have been disabled by

LOOKING EAST OVER THE HEART OF WASHINGTON

This airplane view, taken from over the Potomac, looks directly east along the Mall toward the Washington Monument in the center and the Capitol in the middle distance. At the bottom is the Lincoln Memorial. The Reflecting Basin, a formal pool that throws charming reflections of the Memorial and the Monument, shows as a strip between these structures. From the Monument a park runs to the White House at the left-center of the picture. Pennsylvania Avenue connects the White House and the Capitol and forms the so-called "Triangle" with the Mall and the White House park. The government buildings in the Triangle show white in their comparative newness. In the background the Anacostia River flows southwest to join the Potomac. The Tidal Basin, seen to the right of the Monument, is rimmed with Japanese cherry trees.

wounds or disease while in the service. Southwest of the home is Howard University, for the higher education of colored students. To the east is the Catholic University of America, with its affiliated colleges. Northeast of the Capitol is the Columbia Institution for the Deaf (founded in 1857), including Gallaudet College.

Washington's Logical Street Names

Washington is likely to be confusing at first to the visitor. The whole city is divided into four quarters by North, East, and South Capitol streets, and the line of public parks and grounds stretching westward from the Capitol to the Potomac. These quarters are named, respectively, Northeast (N.E.), Northwest (N.W.), Southeast (S.E.), and Southwest (S.W.). All the diagonal avenues are named, like Pennsylvania Avenue, after states of the Union. The north-and-south streets are numbered, and the east-and-west streets are named with the letters of the alphabet, starting with the central lines of division and working outward. Thus there are two "G" streets and two "14th" streets, widely separated from each other. The Northwest section is much the largest and contains most of the important government buildings, the centers of business, and the fashionable residences.

The site of Washington has no particular advantages for commerce or industry. Practically the only business in the city is catering to the wants of the residents and the many visitors.

The District of Columbia

The District of Columbia has the same boundaries as the city of Washington. Originally it included in its "ten miles square" area 36 square miles on the Virginia side of the Potomac River. The act of Congress creating the District had provided that all government buildings should be on the Maryland side of the river, and the Virginia side was neglected. Half a century later Congress, convinced that this land would never be needed for government purposes, authorized the inhabitants to vote on whether they wished the land to be returned to Virginia. The vote overwhelmingly favored return, so this land was

given back to Virginia in 1846, leaving the district with an area of 69 square miles, eight miles of which is water surface. The city of Alexandria, the Arlington National Cemetery, and Fort Myer thus stand today on Virginia soil.

The government of the district is in the hands of three commissioners appointed by the president with the approval of the senate. The expenses of administration are divided between the citizens of Washington and the Federal government. These citizens have no vote, for it has been found wise to remove from the national capital all questions of municipal politics. Justice is administered by special district courts under laws passed by Congress. In 1871 the experiment was made of constituting the district into a territory, with a governor and legislature, and delegates to Congress, but great political corruption sprang up, and in 1874 the plan was abandoned. The numerous government officials and employees, however, may retain if they desire the right to vote in their home states. The climate is mild in winter, but is subject to violent changes. Sometimes the damp summer heat becomes oppressive. Population of Washington (1940 census), 663,091.

Mirror Lake with the Snow-Clad Peak of Mount Rainier Rising in the Distance

WASHINGTON, STATE OF. Lying in the extreme northwestern corner of the United States, Washington is the twin state of Oregon, and in fact was, until 1853, a part of "Old Oregon." Not until 1863 did it take its present form, between Idaho and the Pacific Ocean, British Columbia and the Columbia River.

Extent.—East to west, 360 miles; north to south, 240 miles. Area, 68,192 square miles (land area, 66,977 square miles; inland water area, 1,215 square miles). Population (1940 census), 1,736,191.

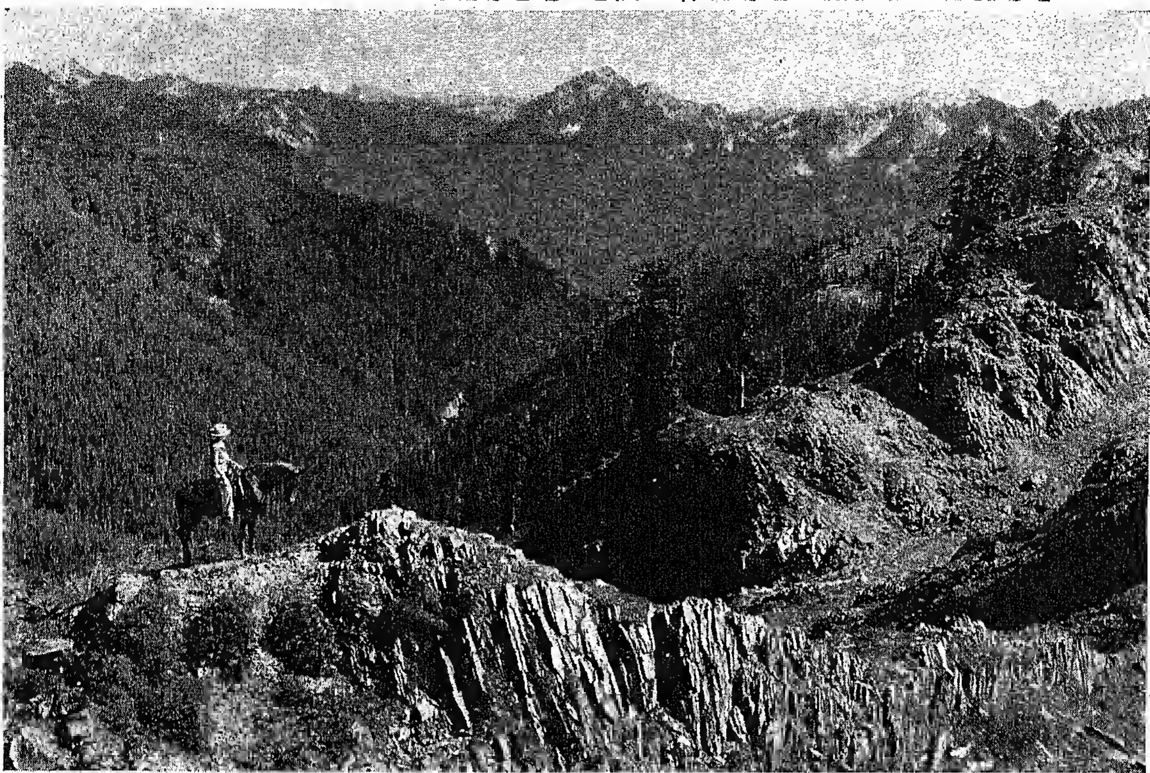
Natural Features.—Comparatively regular Pacific coast line broken by Willapa Bay and Grays Harbor; Puget Sound extending halfway down the state between the Olympic Mountains (northern part of Coast Range) and the Cascade Mountains (Mt. Rainier, 14,408 feet), which cut the state into east and west Washington; Okanogan Highlands stretching east from the Cascades to the Idaho border and sloping to the Columbia, which forms much of the southern boundary. Principal rivers: Columbia and its tributaries (Snake, Okanogan, and Spokane), Skagit, Skykomish, and Nisqually flowing into the Sound. Mean annual temperature, 49°; mean annual precipitation, 35″.

Products.—Wheat, hay, oats, barley, potatoes, apples, and other fruits; cattle, dairy products, sheep, wool, poultry, hogs; lumber products, flour and mill products, meat packing, canned goods, paper products, foundry products, railroad cars, shipbuilding; coal, clay, stone, magnesite; salmon, halibut, and other fish.

Cities.—Seattle (368,302), Spokane (122,001), Tacoma (109,408), Everett (30,224), Bellingham (29,314), Olympia (capital, 13,254).

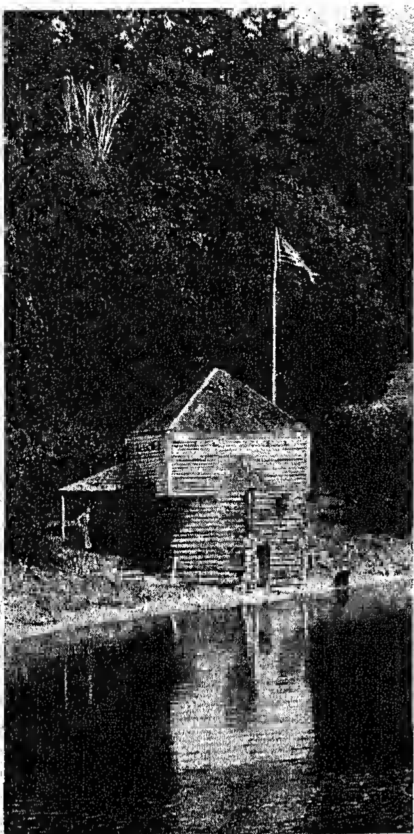
Like Oregon, Washington is divided from north to south by the high and broad wall of the Cascades. The pleasant lands between the mountains and the ocean are breathed upon by cool breezes from the ocean in summer and warm winds in winter, so that flowers bloom every month of the year. The moisture borne by the Pacific winds is precipitated by the cold mountain ranges, giving the western section one of the heaviest rainfalls in the world. Over the mountains to the east it is a different story, with winter snows and blazing summer sun, and a semi-arid climate requiring irrigation to raise crops. Along the Pacific, a few miles inland, runs the Coast Range which rises in the north into the rugged group known as the Olympic Mountains. Between these and the

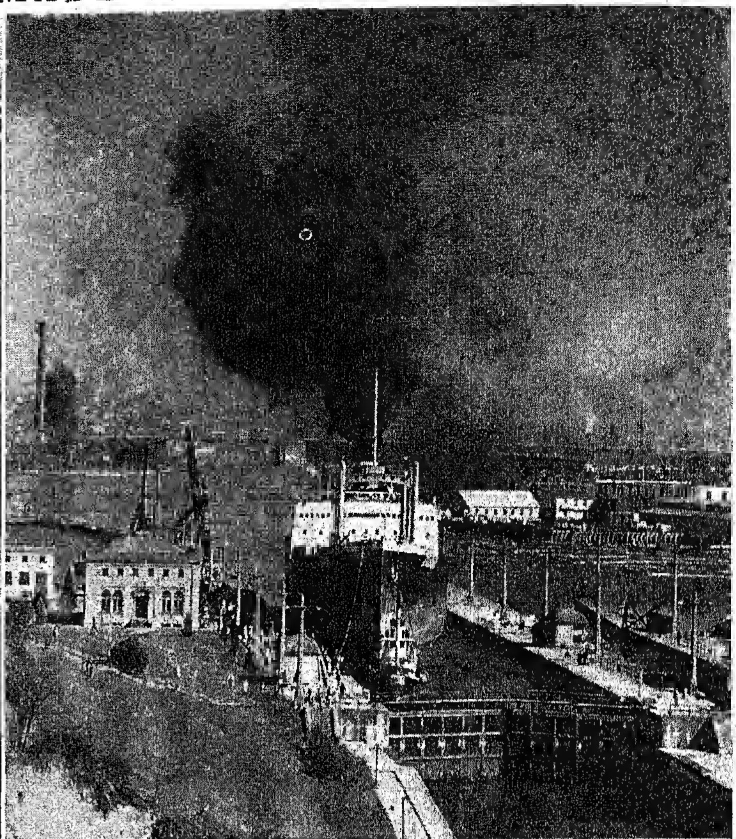
SCENIC CONTRASTS IN WEST AND EAST

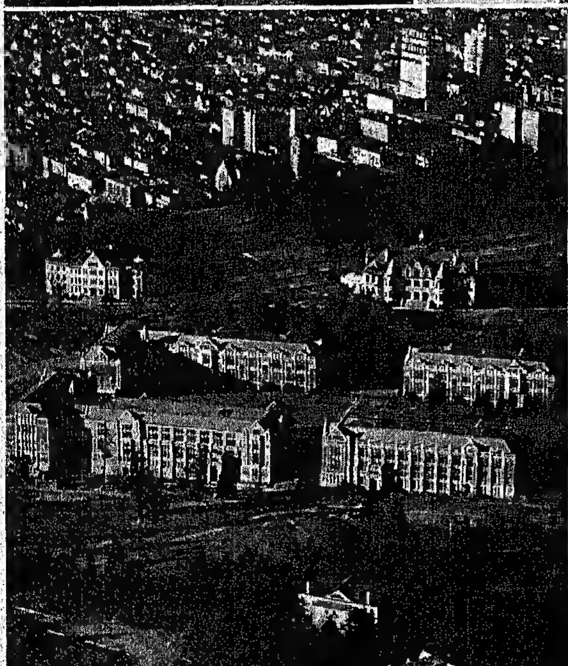


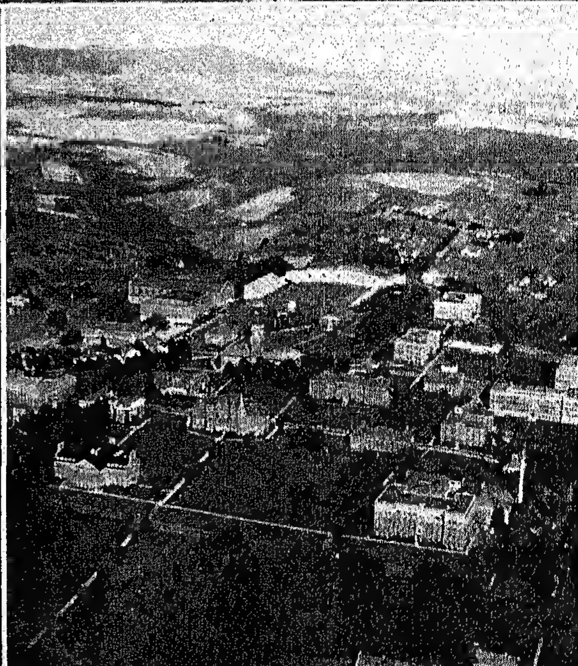
The upper picture shows the forest-clad slopes of the Olympic Mountains in western Washington. The towering heights wring ample rain from moisture-laden winds off the Pacific Ocean. Farther east the winds have lost their moisture and the land is dry, as shown in the lower picture. Here the Palouse River has cut down through a plateau of chocolate-colored basalt, making a straight-sided cliff from each layer. During most of the year the level surface of the region has a golden cover of dry-climate vegetation.

CHANGES MADE IN ONE LIFETIME



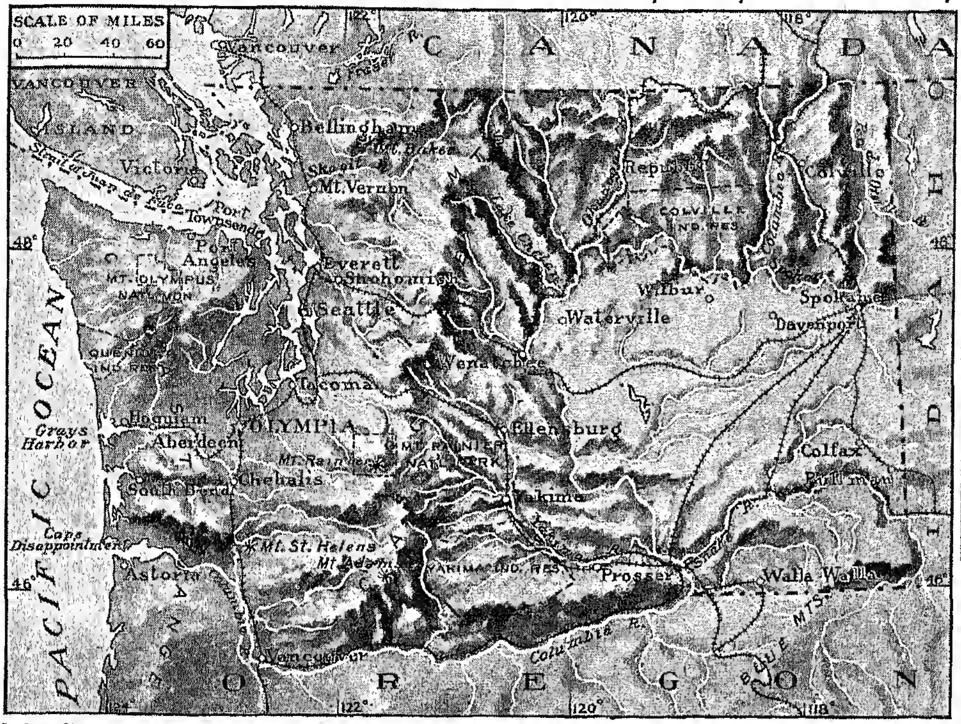


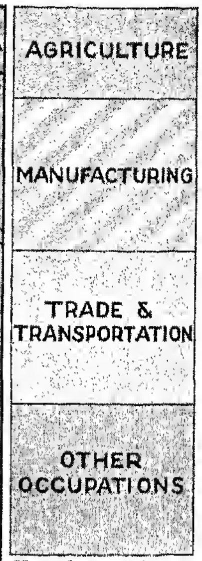




As late as 1872, the British were occupying the log blockhouse on San Juan Island (upper left). Seattle was then a struggling pioneer town. *Forty years later, the city had become a metropolis and a first-rank seaport, and it was digging a ship canal from Puget Sound to Lake Washington to enlarge its shipping facilities.* At the upper right a freighter is passing from the canal into a huge lock which will lower it to sea level. As commerce grew, the pioneers also built up education. The University of Washington at Seattle (lower left) was opened in 1861. The picture shows part of its beautiful tree-clad campus on the shore of Lake Washington. Washington State College (lower right) was opened in 1892 at Pullman, in the southeastern part of the state.

WASHINGTON'S VARIED FACE—SEABOARD, BAY, MOUNTAINS, AND PLAINS

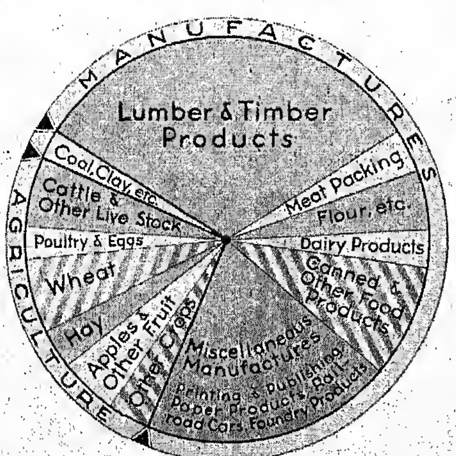




Note the varied surface of this state, mountainous in the west, flat in the southeast, with the wall of the Cascades dividing it. Above, the occupations of the people are compared.

lofty Cascades is the bright tangle of bays and inlets, called Puget Sound, forming one of the finest harbors in the world. This network of water runs halfway down the state; in its most fertile valley and along its shores most of the large cities, Seattle, Tacoma, and Olympia (the capital), are located. The magnificent Columbia River flows south through the eastern half of the state in a sweeping curve known as the Big Bend; then after receiving the waters of the great Snake River from Idaho, it bends sharply to the west and flows to the Pacific along the state's southern boundary, cutting a gorge of matchless grandeur through the Cascades (*see* Columbia River).

Many snowy shining mountain peaks rise on the Cascade ridge, among them the ancient volcanoes of Mount Baker, Glacier Peak, Mount Adams, smooth white Mount St. Helens, and the pride of Washington, Mount Rainier, or Mount Tacoma as it is sometimes called from the name given it by the Indians, meaning "The Mountain that was God." About this icy majestic peak (14,408 feet) Mount Rainier National Park has been reserved, a beauty spot of 377 square miles. Here are lacy waterfalls, the white careering waters of mountain streams, polished lakes, great mysterious glaciers, and forests of tall fluffy humming pines and cedars that were seedlings long before Columbus began to dream of a world that is round and to push daringly across the sea to find the Indies.



The manifold sources from which Washington draws its wealth are here graphically represented.

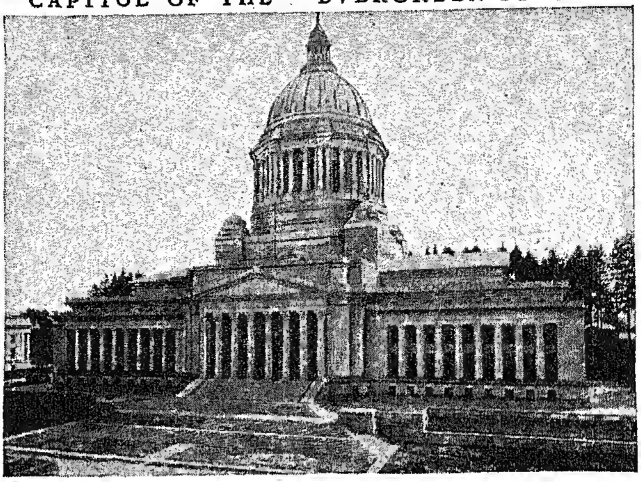
These wide forests of Douglas fir, red fir, white and yellow pine, hemlock, and tamarack extend indeed over most of the tumbled surface of Washington, where they have not crashed before the lumberman's saw, and give the state its popular name, "the Evergreen State." The lumber industry is larger than any other in the state, in the value of its output. But naturally such a state as Washington, with a variety of climates and soils wide enough to supply a nation, does not limit its energies to any one industry. In the rich eastern plains the farmers raise great crops of wheat, oats, barley, and hay, and in the moist western basin and in irrigated valleys east of the Cascades, apples, plums, prunes, and cherries thrive. The state usually leads the country in apple production. Cattle and other live stock thrive on the grassy plateaus and supply milk for the growing dairy industry; fish leaping in the streams, especially the salmon, have made Washing-

ton one of the four greatest states in the value of their fisheries. Cod, halibut, mackerel, and herring are also taken in abundance. From the rocky hillsides come granite, limestone, gold, silver, copper, iron, and lead; and great coal fields in the Puget Sound basin furnish coal to all the Pacific states.

With these raw materials, and with so many mountain torrents and waterfalls to supply power for factories (the state is said to have nearly one-sixth of the nation's potential hydroelectric power), Washington sees every year more and more manufactures turned out, especially of dressed and manufactured lumber, in which it ranks first of all the states. Flour and grist-mill manufactures also rank high, much of their product being exported to the Orient. Copper ore from all over the world is smelted at Tacoma, which has one of the country's largest smelters for copper, gold, and other ores. Iron and steel are also produced.

Tacoma and Seattle are the ports for trade with many lands. Ships from Alaska, Japan, the Philippine Islands, Hawaii, and South America ply the waters of Puget Sound to the very doors of Seattle and Tacoma, and by digging out a few canals hundreds of miles of water front have been made.

CAPITOL OF THE "EVERGREEN STATE"

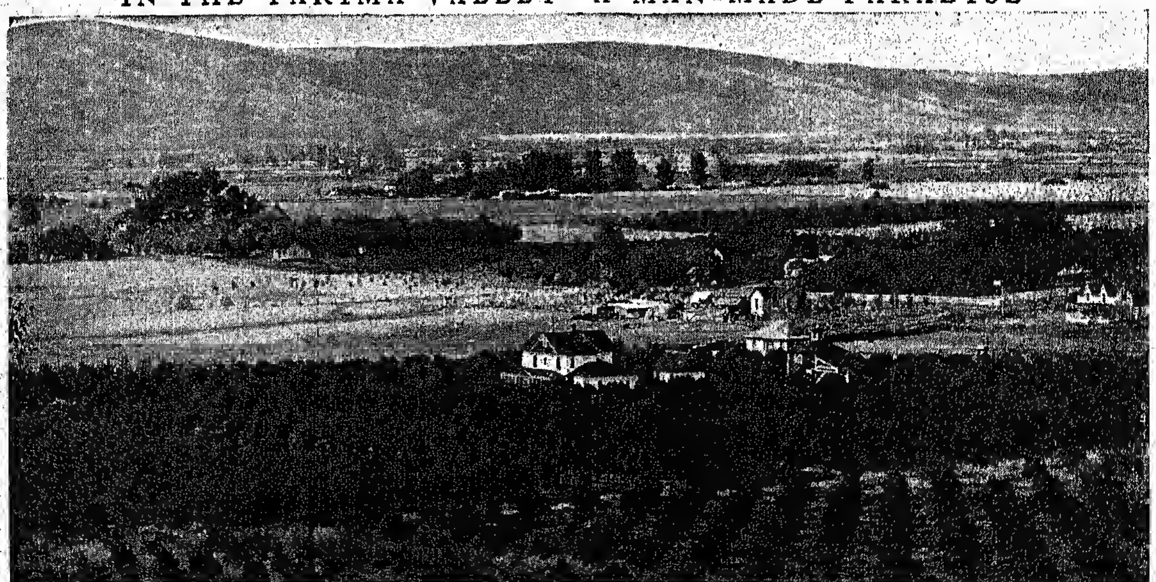


Washington's stately new Capitol at Olympia, completed in 1927, is built of native stone. *Marble from many lands adorns the interior.*

Yet Washington is still just in the beginning of things. Her population is but a handful compared to the people she could support. Although there are a surprising number of fine buildings, good schools, and excellent roads, there are also many acres of the "logged-off" land of the settler, that is, land from which the trees have been cut but from which the stumps have not yet been removed.

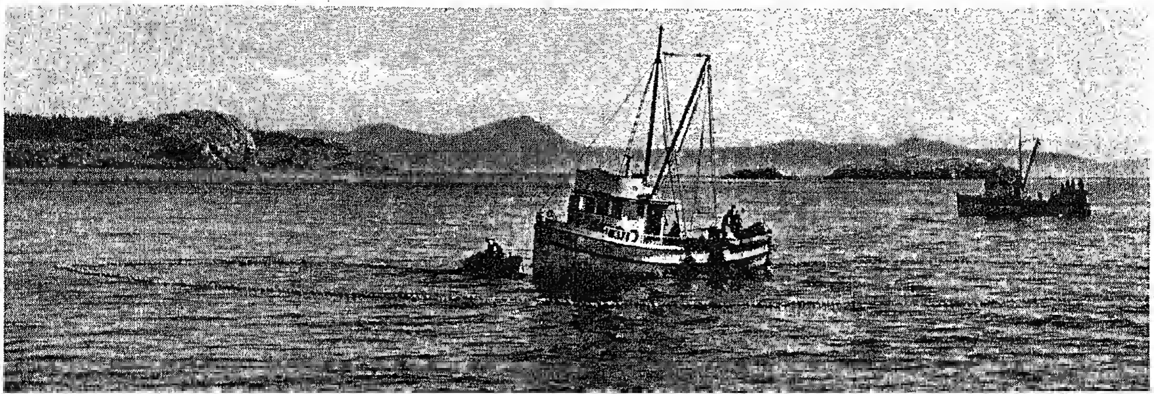
The early history of Washington is the same as that of Oregon, for they were both part of that Oregon territory the title to which was settled by treaty with Great Britain in 1846 (*see* Oregon). Washington was separated from Oregon by act of Congress March 2, 1853, and for 36 years was governed as Washington Territory. During the late '50's occurred numerous Indian wars and wrangles, in which Lieut. Philip Sheridan, who was to be the famous Sheridan of the Civil War, was an active figure. About 1855 also there came up the question of whether Great Britain or the United States owned San Juan Island, lying between the mainland and

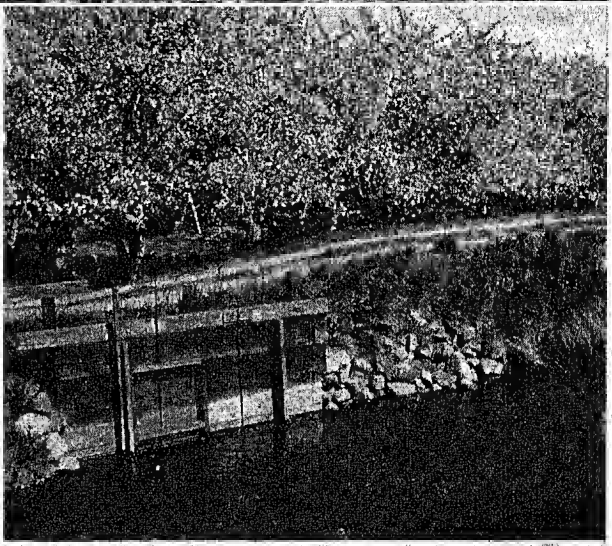
IN THE YAKIMA VALLEY—A MAN-MADE PARADISE

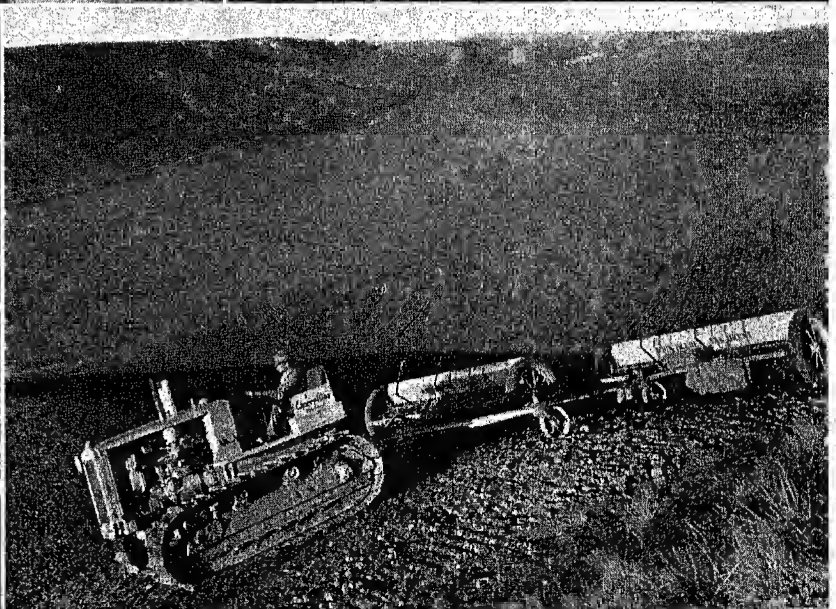


The wonders that can be accomplished by irrigation are shown in the beautiful Yakima Valley, east of the Cascades in the southern part of Washington. The greatest irrigation projects in the state have checkered the country with orchards, farms, and gardens, where a few years ago sage brush and bunch grass struggled for existence.

SEA, FOREST, AND FARMLAND YIELD THEIR RICHES







The waters of the northern Pacific are among the world's great fishing grounds. At the top a boat is purse-seining for salmon in Puget Sound. The mill at the left below helps to make Washington the nation's leading lumber-producing state. Irrigation has brought prosperity to the Wenatchee Valley, famous for its apple orchards (right center), and to the Yakima Valley, which produces fruits, vegetables, hay, and hops. Migratory farm workers pick the Yakima hops (lower left). The rolling hills of the Palouse region in the southeastern part of the state are dry-farming wheat lands (lower right).

Vancouver Island. The island had been settled by both American and British pioneers, and one day a British pig broke pen, made havoc in an American potato patch, and was promptly shot. Then came the question of whether the matter of the pig was to be heard in an American or a British court. About the same time a vigorous American tax collector collected certain British sheep rather forcibly in payment of tax claims. These barnyard perplexities kindled a serious dispute between the two countries which was referred to arbitration in 1872. As a result San Juan Island was given to tho United States and is part of the state of Washington.

During the Civil War the distant state of Washington mustered a gallant band of volunteers. In 1879 the territory first sought to become a state, but admission to the Union was refused. The period from that time until 1889, when she did gain statehood, is known as "the turbulent decade," because of its political and social disturbances. In 1889, the "year of fires," the business districts of Seattle, Ellensburg, Spokane, and Vancouver were burned.

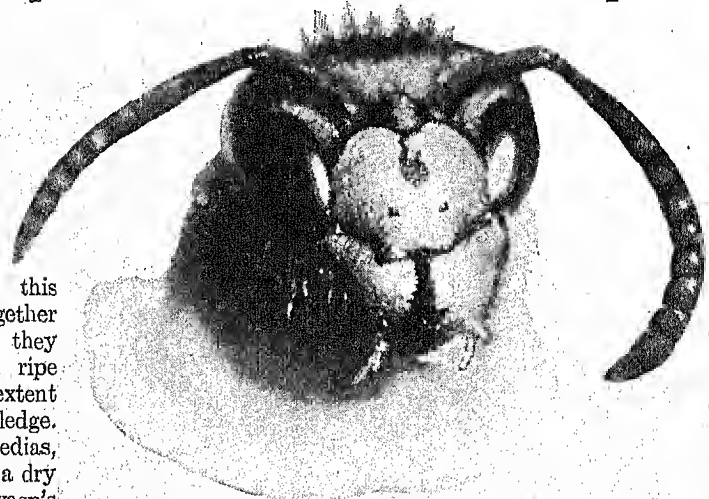
Washington's population in 1860 was only 11,594, but it increased nearly a hundredfold, to 1,141,990, by 1910. Mining attracted many settlers to the eastern part of the state; and completion of the Northern Pacific railroad in 1883 caused a growth from 75,116 in 1880 to 357,232 in 1890. The Alaskan business that resulted from the gold rush to the Klondike in 1897, the rapid rise of the lumbering industry, and the development of irrigation projects under the federal Reclamation Act of 1902 were responsible for the later astonishing growth.

In 1933 the Federal government started large-scale development of the Columbia River at the Grand Coulee canyon and at Bonneville, Ore. This irrigation and water-power project promised increasing prosperity to Washington (*see* Columbia River; Dam).

OUR CLEVER FRIENDS—THE WASPS

Paper Makers, Masons, and Carpenters

WASPS. Most people think of wasps simply as annoying creatures with bad tempers and sharp stings, and until quite recently no one ever bothered about them much except when stung. And this unpleasant habit, together with the fact that they sometimes feed on ripe fruit, was about the extent of our popular knowledge. Even the encyclopedias, after they had given a dry description of the wasp's body and a few of its general habits, usually ended their articles with advice on the best way of killing wasps.



How a Wasp's Face Looks under the Magnifying Glass

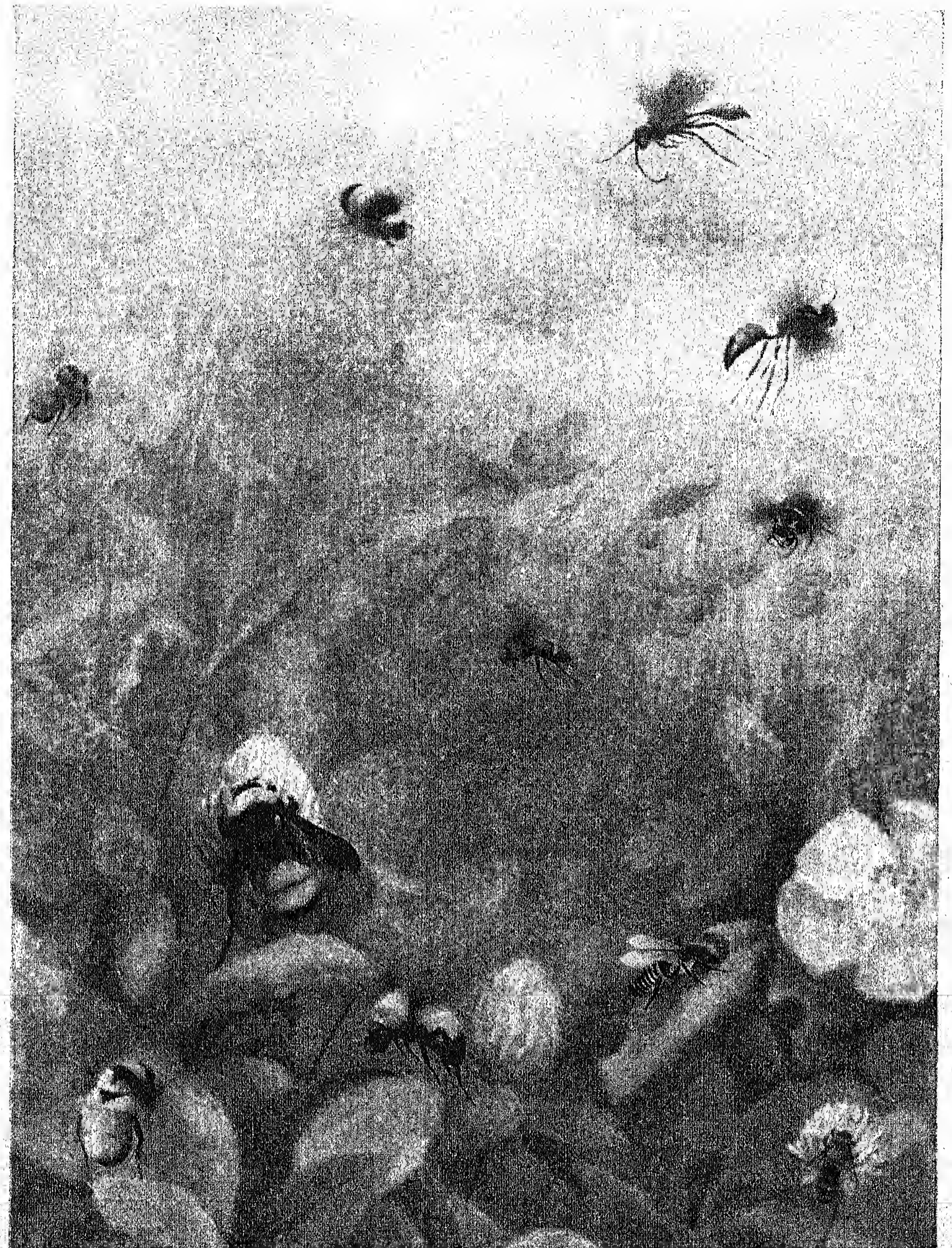
Fortunately in recent years the true student has been going into the gardens and fields and watching the *living* insect at his daily work and trying to get the insect's "point of view." This has been a great benefit to the much misunderstood wasps, which are not only among the wisest of all insects, but also in many cases true friends of men.

Belonging to the same order of insects as the bees and ants, the wasps themselves may be divided into two groups—the "social" wasps and the "solitary" wasps. The former, including the hornets and yellow-jackets, live very much like bees, with queens and males and workers. They are the original paper-makers, chewing up leaves or wood fiber into pulp out of which they build their nests, sometimes in holes dug in the ground, sometimes hanging from the branch of a tree or stuck beneath the rafters of an old house or barn. The large pear-shaped nests of the white-faced hornet are familiar to all country dwellers, and most of the evil reports we hear about wasps come from misguided persons who insist on poking down these nests with a stick. Wasps won't sting unless you hurt or frighten them; bear this in mind, if you want to study these interesting creatures.

Some of the social wasps of tropical countries build huge nests. One species in Ceylon often has homes six feet long; another in South America mixes earth with the paper pulp and with the mixture makes walls as solid as stone.

Annual Rise and Fall of the Wasp Republics

Unlike the hives of bees, the wasp communities last only one summer. All of the members die at the approach of cold weather, except a few queens, who sleep through the winter and in the spring lay the foundation for new nests and new generations. Each queen builds a few comb cells made, like the walls of the nest, of paper. In each cell she lays an egg,

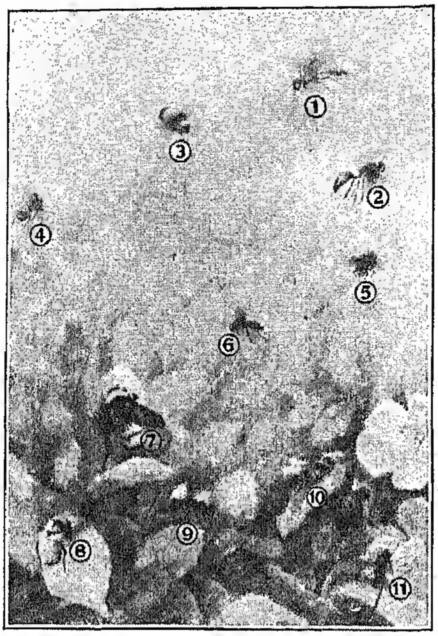


Painting by Bruno Ertz *See text on following page*

THE WASPS AND THEIR BUSY COUSINS

The artist has caught the color and life in a corner of a clover field through the haze of a hot summer day. The wasps and bees whose buzzing you can almost hear are identified on the next page.

THE WASPS AND THEIR BUSY COUSINS



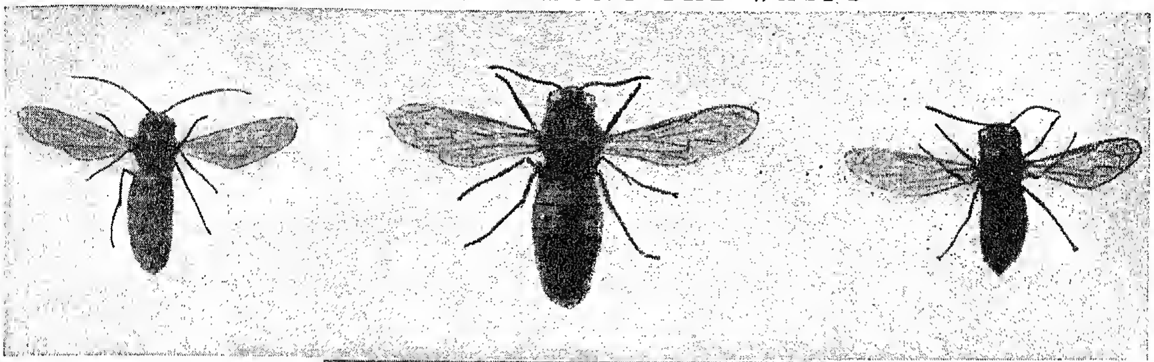
KEY TO PRECEDING COLOR PLATE

MOST of us believe that we can easily tell a wasp from a bee. This may be true of the commoner species we have learned to recognize in the country-side; but when we come to realize that altogether the world contains about 10,000 different species of wasps and 10,000 different species of bees, the task appears more difficult. If we delve into technical descriptions in scientific texts we find that the fundamental distinctions between the two great groups are concealed in such details as the formation of the legs and the structure of the mouth parts. In the bees, solitary as well as social, the mouth parts are better adapted to gathering nectar and pollen from plant blossoms.

So far as habits go, some wasps build hives (more often called simply "nests"), store honey, and maintain queens, just as do the honey-bees. On the other hand, many solitary bees bore into wood, or dig in the ground, or build cells of clay, all of which are activities closely associated in popular science with wasps.

It is fitting and proper then for an artist to bring together representatives of these two great tribes, as has been done on the preceding page. Let us identify them through the adjoining key-picture. The wasps include a Blue Mud-dauber (1), a Golden Digger (2), and a Yellow Jacket (5). The bumblebees are well represented by a Ground Bumblebee worker (4) and a queen (8), and by a Pennsylvania Bumblebee worker (3), a queen (7), and a drone (9). The others comprise a Green Bee (6), a Leaf-Cutter Bee (10), and a Honey-Bee worker (11).

HOME LIFE AMONG THE WASPS

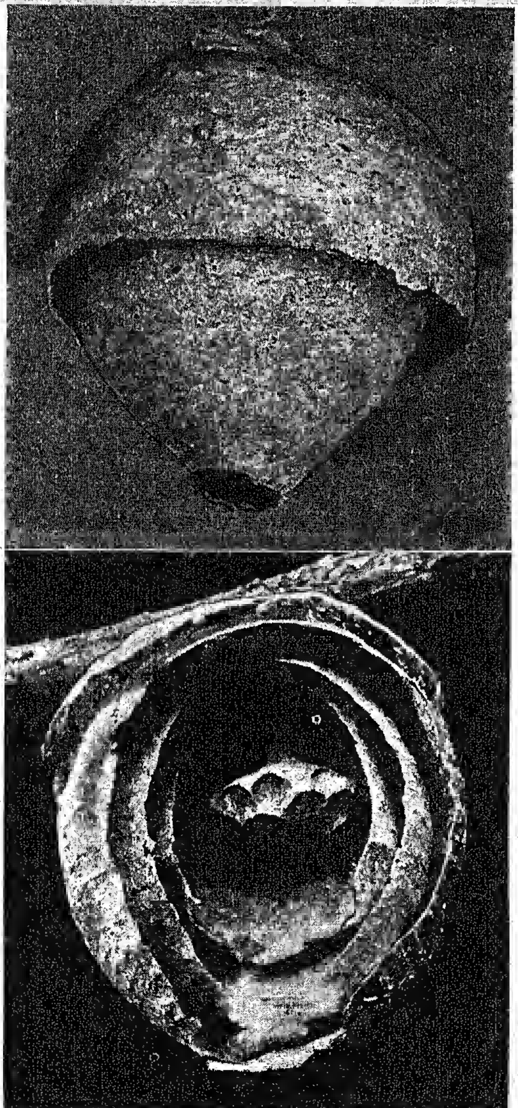


which hatches in about eight days. She then feeds the legless grubs until in about 14 days they become pupae, and 10 days later full-grown workers. These immediately take off her hands the task of enlarging the nest and providing for the new batches of young. As food becomes more abundant the queen produces queen eggs and male eggs, and when food is exceedingly plentiful the workers themselves often develop the faculty for laying eggs.

With the exception of certain tropical honey wasps, all wasps feed their young on animal food, consisting usually of other insects.

While the social wasps exhibit admirable community instincts, it is among the solitary wasps that the most amazing habits and the highest intelligence are found. There are hundreds of species, some as large as hornets, some less than a quarter of an inch long; and their colors vary from dull black and brown to brilliant reds and yellows and blues. Almost every species has some strange habit peculiar to itself, but it is in building nurseries for their young and in hunting and overcoming their prey that they show their most amazing and varied skill.

The mother, among "solitary" wasps, is confronted



At the top are shown the three types of Wasp: at the left, the male or drone; next, the queen; at the right, the active little worker. Below are the nests of a certain kind of paper-making Wasp. One of them is cut open to show how the comb is protected by several layers of paper to make the nest waterproof.

with the fact that her children are very greedy and will only be satisfied with the flesh of living or recently killed prey. She must, therefore, not only build a safe nest in which to lay each egg, but must stock that nest with fresh food on which the waspling may begin feeding the moment it leaves the egg. This task is more difficult than might appear, for each species of young wasp demands its own particular kind of food. One eats only a certain kind of fly; another requires a carefully chosen caterpillar; a third will have only spiders; others dine exclusively on special beetles, grasshoppers, crickets, cockroaches, ants—but the list is too long to be given entire.

Let us follow the caterpillar wasp (*Ammophila*) on a hunting expedition. She has built her nest in the ground, hidden perhaps under the leaf of some plant. It consists of a tunnel an inch or two long, leading down at a sharp angle to a small pocket. Before departing for the chase, she carefully closes the opening with a lump of earth and smooths it over so the keenest eye can hardly find it; then after a careful survey of the neighborhood, as if to fix the spot in her memory, she is off on her quest for provisions.

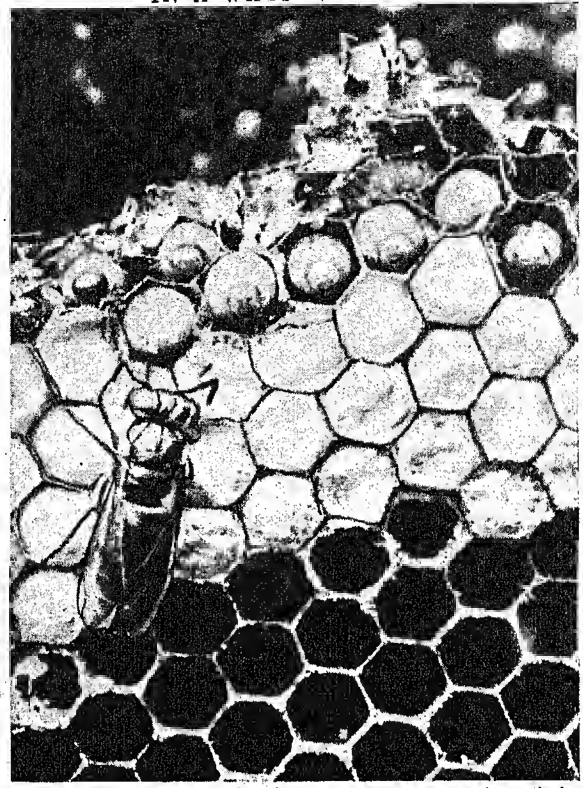
It may take a few minutes or several hours, but sooner or later she finds her game—a green caterpillar resting on a leaf. She attacks at once, and her strong jaws soon close over its back near the head. Standing high on her long legs, the wasp then lifts the front of the caterpillar from the ground, curves the end of her long abdomen underneath, and thrusts in her sting between two segments of her victim's body. At once the caterpillar becomes limp and helpless. The sting is withdrawn and plunged carefully between other segments.

Now she picks up her prey and, half running and half flying, makes her way back to the nest. She digs out the opening, drags the caterpillar inside, lays an egg on one of its middle segments, comes out, closes up the hole carefully, and is off hunting again.

But here is the strange thing: The caterpillar *is not dead.* With the skill of a trained surgeon, the wasp has thrust her poisoned lancet into the nerve centers which control the creature's motion, leaving it alive but paralyzed. In this cruel but necessary manner, she has made sure that the food supply for her young will not decay or dry up before the egg hatches two or three days later.

How the wasp knows where those delicate nerve centers are situated is one of Nature's mysteries. Comparatively few people realize that the motor nerves of insects and spiders are situated on the under side, instead of along a spinal column at the back, as in the higher creatures. Yet the solitary wasp seems to be born with that knowledge. There is a species of beetle-hunting wasp of Europe, described by that great French naturalist Henri Fabre, which is compelled to press down upon the body of its victims in order to open the one joint in their armor through which the sting, with unerring accuracy, can reach its mark.

IN A WASP NURSERY



The young Wasp which has just emerged from its chrysalis is trying out its powers by walking over the paper-capped cells in which its brothers and sisters are still tucked away. The caps are put on by the grubs themselves just before they settle down for a nice long sleep in the silky cocoons they have spun for themselves. In some of the upper cells the cap has not yet been made and you can see the fat white grubs almost filling their cosy quarters.

The tarantula-killer of the American Southwest by clever tactics induces her dangerous prey to rise in defense on its back pairs of legs, exposing the vulnerable spot on the big spider's breast. A quick thrust of the wasp's sting disables the monster, and it has been known to remain alive but motionless for more than five weeks after this operation.

The quantity of food stored in each nest varies greatly. A single larva of a certain fly-catching wasp (*Bembex*) has been known to eat 82 flies in eight days. The mother wasp in this case lives in the nest herself and builds side tunnels for nurseries and storehouses, feeding and watching over her young as they grow up.

The digger wasps do not show so great a skill in home building as the carpenter wasps and the mason wasps. The former bore holes in trees or old posts, or clear out the pith from the stems of certain bushes to make room for their nursery cells. The mason wasps, which include the common "mud-daubers," usually construct their cradles of mortar and small stones on walls or sun-heated rocks. The greatest skill and nicety is used in the selection of material and the shaping of the structure.

MOTHER WASP'S TAMPING TOOL

Much as men by machinery lift and let fall great weights in driving piles, or a foundryman uses his tamping tool in tamping the sand in his mold, this Digger Wasp uses pebbles to hammer down the earth over its nest.

Yet it is among the digger wasps that we find what is perhaps the only case of the use of tools by lower animals. George W. Peckham and Elizabeth G. Peckham describe this amazing habit in their fasci-

nating book 'Wasps, Social and Solitary', which has become a world classic. They tell how they saw a wasp of the genus *Ammophila* repeatedly take up in her jaws a small pebble with which she hammered down the earth over her nest, dropping it to pile on more earth, and seizing it again to pound. Other observers have recorded similar experiences.

"So far as I know," says the great nature student, John Burroughs, "there is no other animal on this continent (America) that makes any mechanical use of an object or substance foreign to its own body in this way."

Although some wasps attack and destroy large numbers of domestic bees and a few species injure trees by gnawing them, the wasp tribe as a whole do mankind a tremendous service by destroying numbers of harmful bugs, beetles, flies, and caterpillars. Before killing a wasp, therefore, it is well to try to find out whether it is friend or foe.

A QUEEN'S LONG WINTER NAP

When this Wasp Queen decided to go to sleep for the winter, she gripped a netted curtain with her jaws, let go with all her legs, and hung there dormant and seemingly lifeless until the warm weather of spring.

Many of the wasps have between the thorax and abdomen the slender joint which has given rise to the popular term "wasp waisted." Most of the hornets, however, lack this feature. The mouths of the wasps are built for sucking, but less perfectly than those of bees, so that wasps can draw nectar from shallow flowers only.

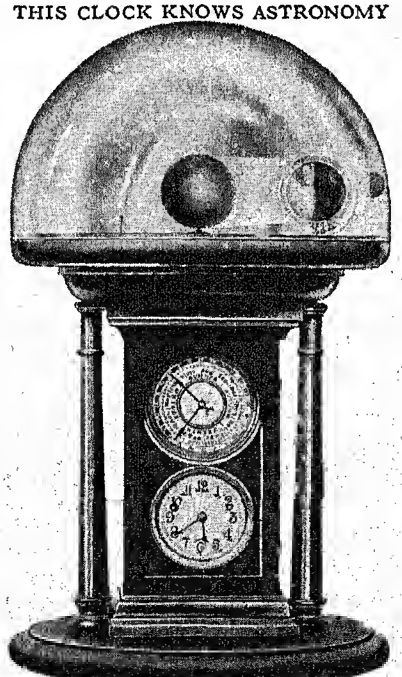
The so-called "velvet ants," the largest of which is the Texan "horse ant," are really not ants at all but wingless relatives of the wasp tribe, as is shown by their sharp stings. Wasps belong to the order of insects called *Hymenoptera*, and are divided into two super-families, the *Vespoidea* and *Sphecoidea*, the former including all the social wasps and a few of the solitary varieties. The *Vespoidea* (true wasps) include the families *Vespidae* (hornets, yellow-jackets, and social wasps), *Eumenidae*, and *Masaridae* (solitary wasps). The hornets and yellow-jackets form the genus *Vespa*. The *Sphecoidea* are mud daubers.

MACHINES *that* MEASURE TIME

WATCHES AND CLOCKS. At first men had no way of measuring time by day except by the position of the sun in the sky and the shadows it cast, and by night they could only guess from the position of the stars. The movements of the heavenly bodies did not mark time into such exact intervals as we have in the hour, minute, and second. Even highly civilized Greeks of the age of Pericles indicated time by such vague terms as "dawn," "full market," "noon," and "sunset."

Long before this, however, the Babylonians and the Egyptians had learned to measure time more accurately by the sundial. An early form of this was an L-shaped bar, with the short arm upright. When placed facing the east the shadow of the upright traveled inward from the end of the bar. At noon the position of the bar was reversed. On it were marks indicating divisions of time roughly corresponding to our hour. Other types of sundial were flat or hemispherical, with an upright rod in the center. The Babylonians discovered that greater accuracy could be obtained by making the *gnomon* or upright slant toward the North Pole, so that the shadow came nearer to moving equal distances in equal times.

THIS CLOCK KNOWS ASTRONOMY

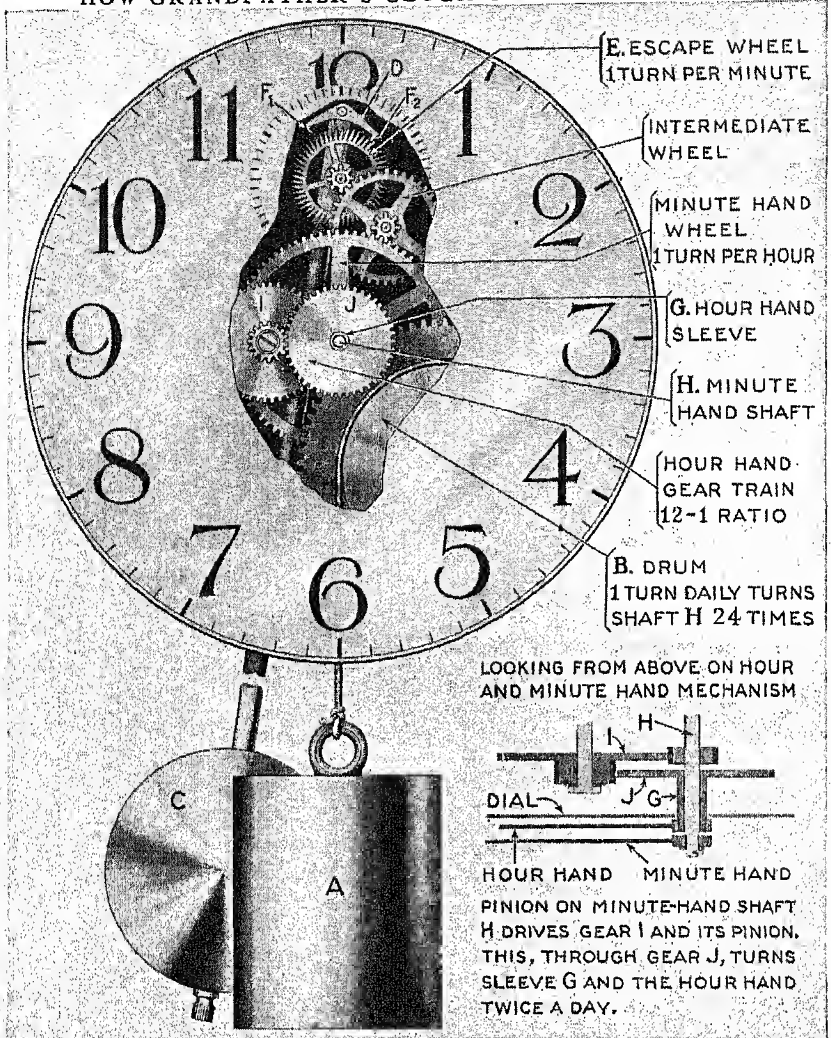


This clock shows the movements of the earth and the seasons, and predicts eclipses.

An ancient timekeeper that needed no sunshine was the *clepsydra* or water clock. Such devices were used by the Egyptians, and were improved by the Greeks and Romans. They were probably invented independently by the Babylonians and Chaldeans, and were commonly used in China until recent times. One style of clepsydra allowed water to drip through a small hole in the bottom of a jar; as the water in the jar lowered, it exposed marks telling the hours. Another type gathered the dripping water, and used the ever-increasing weight to drive a pointer around a dial.

In the Middle Ages the "hour-glass" or "sand-glass" was generally used in Europe. In this instrument, sand runs from one hollow glass cone to another through a tiny hole in the center, the quantity of sand being care-

HOW GRANDFATHER'S CLOCK COUNTS ITS TICKS



The power for a "grandfather's clock" comes from a weight A turning the drum B, which, through various gears, turns the hands. The turning speed is controlled by the pendulum C, operating through the escapement, consisting here of the detent or lock D at the top of the pendulum rod, and the escape wheel E. As the pendulum swings to the right, the pallet F_2 is drawn out of engagement with the escape wheel and the wheel begins to turn under the pull of the weight. But it is promptly caught by the descent of pallet F_1, which engages a tooth on the other side. Between the two the escape wheel moves forward only one tooth's distance. The same action is repeated when the pendulum swings back. As each pallet releases a tooth, the escape wheel, starting to turn, gives it a "kick," and these successive kicks keep the pendulum swinging. The train of gears drives the hands at different speeds, the hour hand being attached to sleeve G, inside which revolves the shaft H carrying the minute hand. Below at the right are details of the gear train. The teeth of the escape wheel make the ticks of the clock.

fully measured out to run out in a certain number of minutes. Ships at sea kept their time in this way.

Some time during the Middle Ages, the first weight-driven clock was invented. In this form of clock a weight, attached to a cord or chain, turns a set of geared wheels which operates a pointer traveling around a dial. Many such clocks had no faces but told time by striking a bell every hour. Indeed, our word "clock" comes from the French word *cloche*, meaning "bell."

While the exact origin of mechanical clocks is not known, it is said that Pope Sylvester II invented one about 990, and William, Abbot of Hirschau, is credited with another in the 11th century. Westminster had a clock in 1288 and Canterbury in 1292, and we know details of construction, beginning with the Glastonbury Abbey clock (1335), made by Peter Lightfoot, and the noted one made for Charles V of France in 1379, and installed in the tower of his palace in Paris by the German, Henry de Vick.

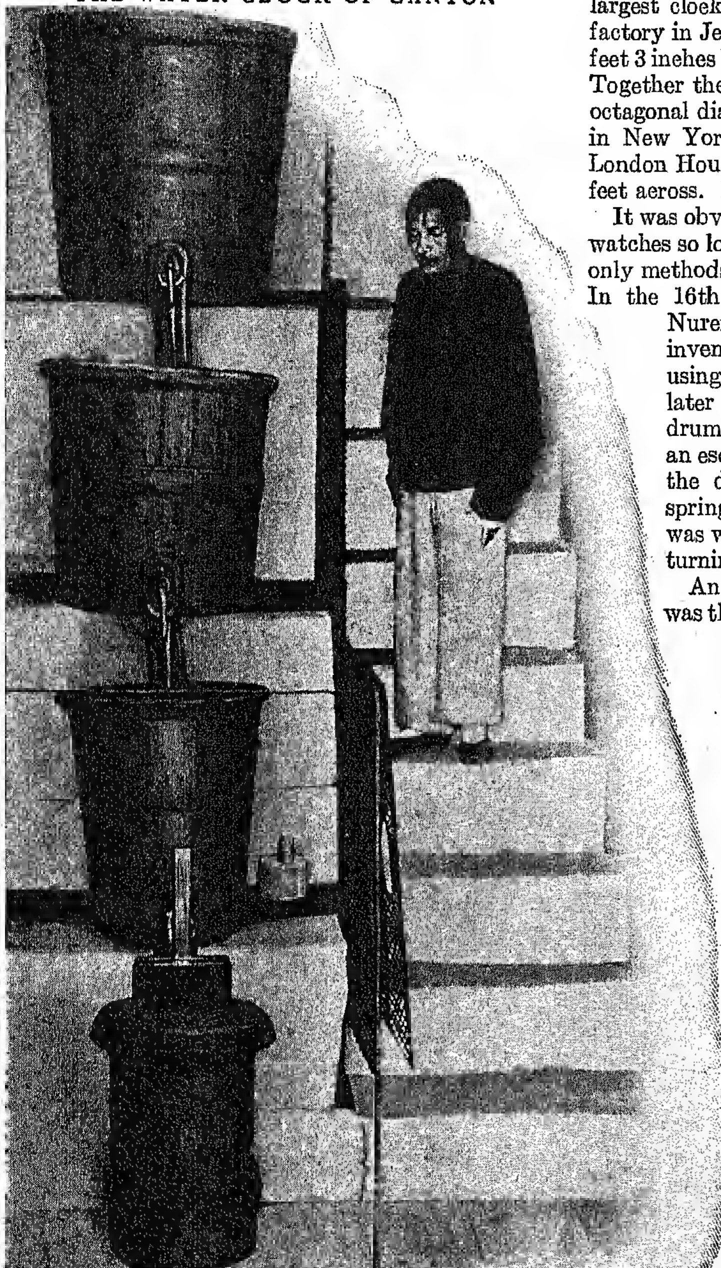
Obviously, if the weight used to provide driving power in these clocks were allowed to fall freely, it would spin the hands violently for a short time, then would need rewinding. To prevent this, some device, such as an escapement, was needed to control the weight, letting it fall only a short distance at a time; and some device was needed to make the escapement release the weight for its successive falls in uniform intervals of time. Seventy-five years after Galileo (*see* Galileo) in 1581 proved that successive beats of a pendulum always take place in equal intervals of time (*isochronism*), Christian Huygens in 1656 applied this principle to clocks; thereafter the weight, escapement, and pendulum were combined as we see them in the "grandfather's clock." The accompanying picture shows their interaction and shows plainly how the rate of swing of the pendulum controls the rate at which the hands turn—that is, determines the "time" told by the clock.

Some of the early clocks were marvels of ingenuity, and included all sorts of automatic attachments which had nothing to do with telling time. The most famous of these is the Strasbourg Cathedral clock, 30 feet high. It not only tells the time of day, but also the day of the week, the month, and the position of the moon, the planets, and the stars as seen at Strasbourg. Each day of the week is indicated by a little figure; on Sunday Apollo appears, on Monday Diana, on other days other deities. Each day at noon the

Twelve Apostles parade before a figure of Christ, while a cock flaps its wings and crows.

Cuckoo clocks, from which a little wooden bird pops out, sounding the hours, have one of the simplest forms of automatic attachments. Alarm clocks are fitted with a mechanism to ring a bell at any set time. Mantel clocks and other striking clocks contain a "striking" movement which marks the hours.

THE WATER CLOCK OF CANTON



The Chinese claim that they used the clepsydra more than two thousand years before Christ. In this one the water drips slowly from one copper jar to the next. In the lowest a float marks its gradual rise. It takes 12 hours to transfer the water from the topmost to the lowest jar.

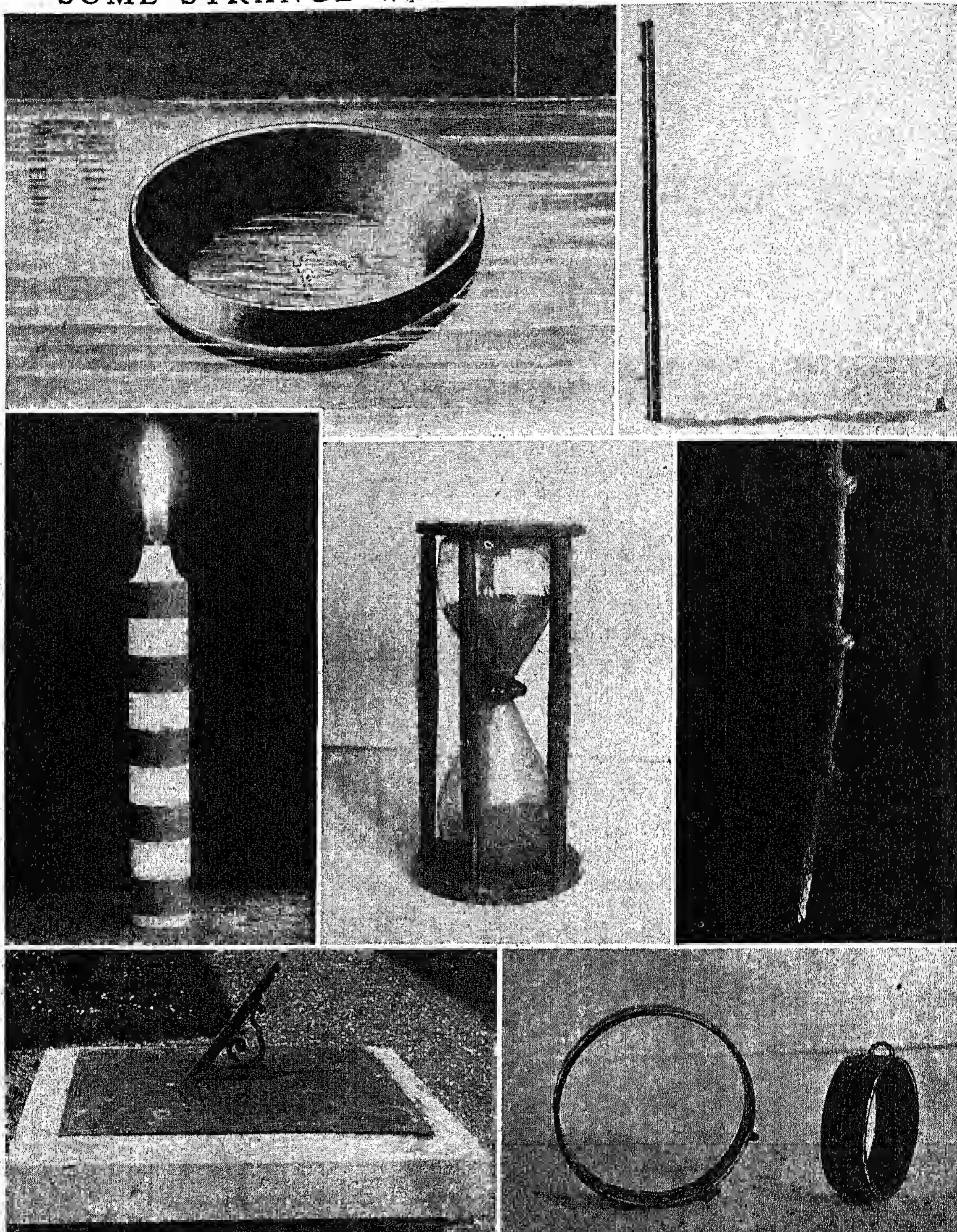
The giant "tower clocks" seen on buildings generally are equipped with a special form of escapement, the "gravity" type, in which arms on each side of the pendulum are raised by the turning escape wheel, then allowed to fall against the pendulum, making it swing. They usually have great pendulums 9 to 13 feet or more in length, and powerful electrically wound movements that function despite the pressure of wind and the weight of snow and ice on the hands. The largest clock in the world was built for the Colgate factory in Jersey City in 1924. Its minute hand is 37 feet 3 inches long and the hour hand is 27 feet 6 inches. Together the two weigh nearly four tons. The great octagonal dial, 50 feet across, can be read miles away in New York harbor. The Big Ben clock of the London Houses of Parliament has four dials, each 23 feet across. Its minute hand is 14 feet long.

It was obviously impossible to make small clocks or watches so long as the weight and pendulum were the only methods of furnishing and regulating the power. In the 16th century the Germans—Peter Hele of Nuremberg is usually credited with the actual invention about 1500—hit upon the idea of using a spring to furnish the power. As it was later developed, the spring uncoiled inside a drum, and the drum acted through gears and an escapement to turn the hands. In watches, the drum usually is called a *barrel*, and the spring is the *mainspring*. In earlier watches it was wound with a key, but now it is wound by turning the stem.

An effective substitute for the pendulum was the balance, originally just an equal-armed lever with weights on the ends, but later in the form of a wheel. The balance wheel has finely adjusted weights about its rim, and is provided with a hair-spring, one end of which is fastened to a support, and the other to the staff on which the wheel turns. As the wheel turns first one way, then the other, it coils and uncoils the spring. As the spring coils and uncoils in equal intervals of time, it provides the uniformity which the swings of the pendulum give to a grandfather's clock. The first use of a coiled spring in watches is credited to Robert Hooke, about 1660.

The balance wheel controls the speed at which the works turn the hands through an escapement connection similar in principle to that used in the grandfather's clock. A widely used type has a disk, called the roller, connected to the balance wheel staff and rotating with it. One surface of the disk bears a roller pin, around which are two "tines" of a fork. The piece bearing the fork (called the pallet-fork-and-arbor) is pivoted, and at its other end are the pallets,

SOME STRANGE WAYS OF MEASURING TIME



Here are a few of the simple devices which men have used in various ages and in various lands for measuring units of time. At the top a stone dish with a small hole in the bottom is set afloat on water. It takes perhaps three minutes to sink and strike bottom —just long enough to boil eggs. Next is the "stick and shadow" method; then the candle which burns from stripe to stripe every 30 minutes; next is the hour-glass with its running sand; next a rope smoldering away from knot to knot; and at the bottom two types of sundials. All such time-measuring devices were of course more or less unreliable; and, except for the sundials, they were not really "time tellers" at all, since they only measured brief periods without telling the true time of day.

which lock and release the teeth of the escape wheel, and also receive the impulses which keep the balance wheel moving.

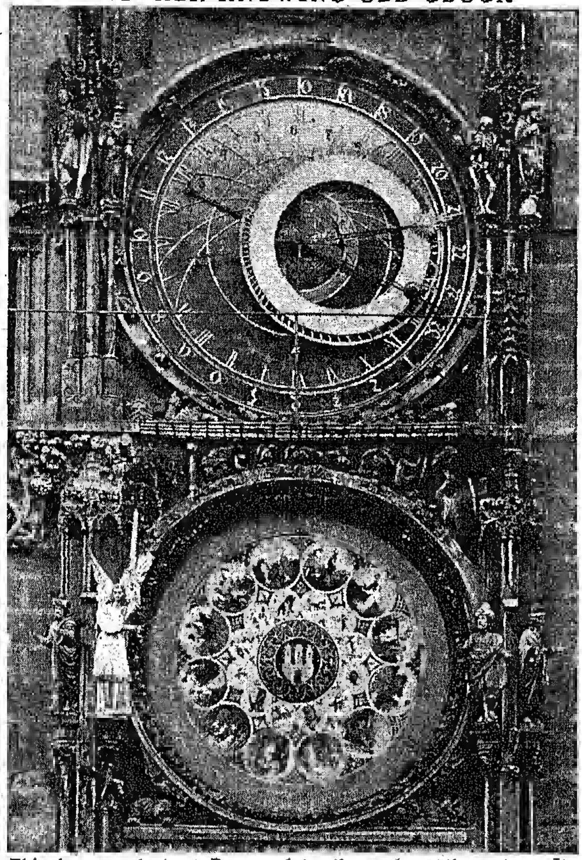
All these parts must be made with precision, since the slightest inaccuracy affects the watch's timekeeping qualities. The springs in particular must be accurately made. The trouble encountered by early watchmakers—lack of uniformity in the power furnished by the mainspring as it uncoils—is now met by making the spring diminish in size from one end to the other. The balance wheel hair-spring also varies in power, according to temperature. This variation is offset in good watches by using a compensation balance. The rim of such a balance wheel is not a complete circle, and is made of an outer layer of brass and an inner layer of steel. These metals expand unequally under heat; so when the temperature rises, weakening the hair-spring, the greater expansion of the brass on the outside of the rim turns the ends in, lessening the inertia of the wheel and making it easier to drive, thus compensating for the weakness of the spring (*see* Automatic Devices).

A full-jeweled watch has 23 jewels, most of them used as bearings, or pivots. Each of the three wheels in the main gear train has two; each bearing of the escape wheel, balance wheel, and the pivot of the pallet-fork-and-arbor has two jewels. The shaft, called an *arbor*, on which the mainspring is coiled, has two, and two more are used as pallets. The odd jewel (the number used always is odd, from 5 to 23) is the roller pin. Sapphires, rubies, and diamonds are the jewels commonly used.

A stop watch has an extra train of gear wheels which can be linked into the main train by pressing on the stem, and unlinked by pressing a second time. A third pressure operates a cam which brings the special hand back to zero.

Chronometers (from the Greek words "time" and "measure"), because of their remarkable precision,

ANOTHER KNOWING OLD CLOCK



This famous clock at Prague dates from the 15th century. Its upper dial not only records the time of day, but also indicates the time of year and the corresponding positions of the sun and moon. The lower dial shows the months of the year and the signs of the zodiac. Every hour, the clock comes alive. A cock crows, the clothed figures beside the dials go through a pantomime, and the skeleton (Death) tolls the hour.

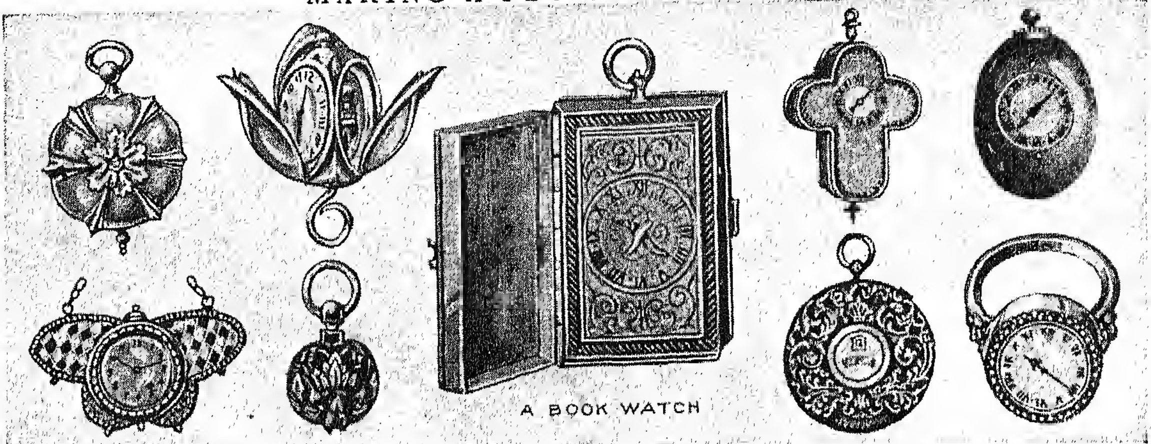
are much used at sea in making observations (*see* Navigation). They differ from watches in the type of escapement used. Instead of operating a pallet-fork-and-arbor, the roller pin works against a spring, pushing it to one side and letting it come back to release and lock the escape wheel. The "fast and slow" adjustment uses two pins, one on each side of the hair-spring near one end, and almost touching it. When the pins are moved to one side or the other, the spring in effect is made shorter or longer, and so moves faster or slower.

Chronoscopes or *chronographs* are precision instruments made to measure and record minute periods of time. They are used in astronomical observations, to determine the speed of projectiles, and for similar purposes. Some of them can record the five-thousandth part of a second.

Watch cases either are "open face" or have a "hunter case," with a lid that snaps open or shut over the face. Sizes are numbered from the 0 size, $1\frac{5}{30}$ of an inch across, and the number increases one for every thirtieth of an inch over that size. Smaller watches are numbered 1-0, 2-0, etc., for each thirtieth under 0 size. The first watches were large and round, called "Nuremberg eggs," from their shape and from the German city in which they were made. For several centuries people delighted in fancy cases and toy attachments. Mary, Queen of Scots, had a watch in a case shaped like a skull; others were shaped like books or crosses.

Clock and watchmaking was largely a family trade, fathers teaching their sons from generation to generation. The application of power-driven machinery and the use of interchangeable parts, so that mass production was possible, was accomplished largely through the efforts of the New Englanders Eli Terry (1772–1852), Seth Thomas (1785–1859), and Chauncey Jerome (1793–1860). Switzerland seized upon the new machinery, and used it to such effect in producing inexpensive, good quality timekeepers that Swiss watches won a world-wide market and reputation.

MAKING A PET OF THE WATCH



Watches are so small, so friendly—snuggling in your vest pocket or hanging about your neck, that it isn't strange that they have been made pets of and dressed up in all sorts of quaint forms. And this has been done for a long time. The oval watch at the right, for example, belonged to Oliver Cromwell and the ring watch once adorned the royal finger of George III. Crosses and flowers also were favored novelties in the centuries when watches were new.

The Americans did even better, finally producing watches and clocks that could be sold for a dollar or less and were guaranteed to keep good time.

How Machines Make the Parts

When you visit a watch factory you are confronted with amazingly complicated machines. Some stamp out the round skeleton "blanks" from which the wheels are made. Holes are drilled in the middle of the wheels and a number of them are strung on a rod like beads on a string. Then the rod is clamped in a milling machine, and a whirling gear-tooth cutter passes along the row of blanks, cutting out the spaces between the teeth on the wheels.

In another department miles of small wire are fed into automatic screw machines. A small bit is snipped off, the head of the screw is formed, the point is tapered, a slot is sawed across the top for a screwdriver, the threads are cut, and the whole screw is polished, in almost less time than it takes to read this. One machine makes thousands of tiny screws in a day, some so small that 20,000 would hardly fill a thimble. Among the most delicate parts of a watch are the springs for the balances. The average human hair is about three and one-half thousandths of an inch thick (0.0035 inch), and many hair-springs are only a third as thick as that. Steel wire of the finest quality is drawn through a series of diamonds pierced with smaller and smaller holes, until finally the wire emerges as a tiny filament about one-thousandth of an inch thick and only a little wider. The pound of steel is now a thread eight miles long, and worth over $60,000! The wire is then tempered, coiled, and blued, usually by girls using powerful magnifying glasses to aid them.

A WORLD TIME CLOCK

The globe is turned by clockwork and tells what time it is at any given moment in any part of the world.

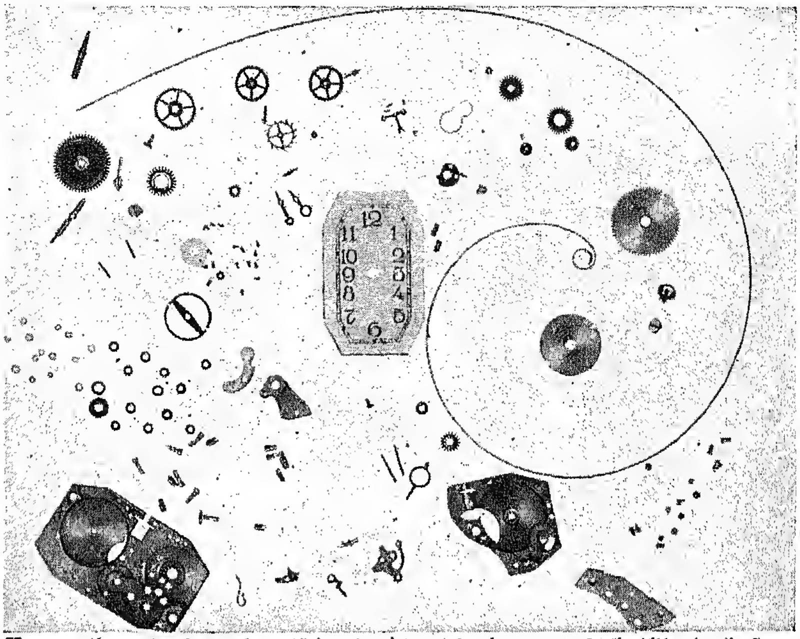
In other parts of the plant machines are turning out balance wheels, jewels, hands, pivots, pins, and other parts almost without number. Watch dials are stamped out of sheets of copper, sprinkled with powdered porcelain, and fired to make enamel dials. Numerals and letters are printed by an off-set process with black enamel ink or waterproof color varnish. Metal finished dials have copper bases and silver or gold surfaces. Letters and figures are either printed on, or are cut out of the metal and brazed. "Radium dials," which glow in the dark, are coated with luminous paint mixed

with colored adhesive varnish (*see* Paints and Varnishes).

Finally the parts, finished and partly assembled, go to the "finishing room," where they are brought together and the complete watch movement is assembled. Many of the parts —about one-third of them screws—are so small that the watchmakers must use delicate tweezers to handle them, and strong magnifying glasses to place them properly. After an inspection, the watches are regulated, tested for temperature error, and put in cases.

It takes a year or more, and nearly 4,000 operations, to complete a watch. Highly specialized operations are done on machines so intricate and wonderful that watch factories themselves must make them. The details of many of these machines are kept secret; it may take two or three years to design a machine and as long to build it; some have nearly 60,000 parts. So a modern watch plant is also a large machine shop, with machinists, toolmakers, diemakers, and designers.

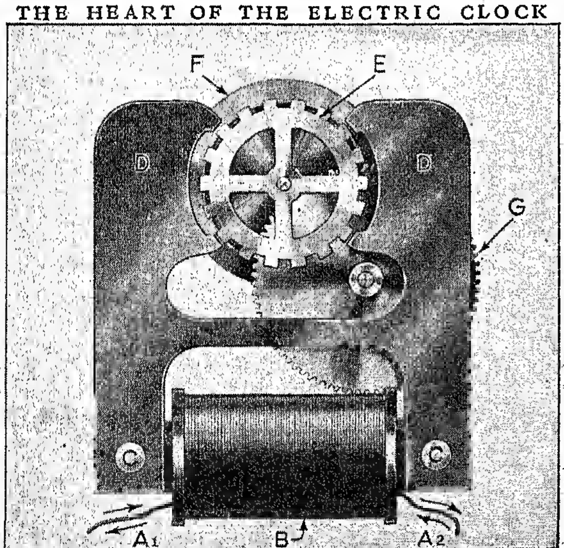
OVER 125 PARTS IN THIS WATCH



Here are the parts of a modern 17-jewel wrist watch, shown practically "life-size." Compared to the old-fashioned round movement, this form is much simpler and, in small sizes, is easier to manufacture. There are more than 125 parts shown in this picture. Many of them are hardly larger than a grain of coarse sand, yet each is perfectly finished.

America's chief source of time measurement is the Naval Observatory at Washington, where observers check the movements of the stars against master clocks in airtight cases (*see* Astronomy). These clocks are used in sending out time signals by wire and radio. The average error in sending these signals throughout a year is as low as $\frac{32}{1000}$ of a second. Yet even these clocks are being superseded by the Shortt clocks, which tell time to within one second in a hundred million! These employ a pendulum swinging freely, save for electric contacts and a correctly timed impulse from a weight. The pendulum thus is mechanically free to swing in its proper period. Electric current passing through the contacts drives a "slave" pendulum, which controls the timekeeping mechanism.

THE HEART OF THE ELECTRIC CLOCK



When alternating current enters the coil B through the wires A_1, A_2, the coil's core C, C is magnetized in alternate directions. This fluctuating polarity is transmitted to the arms D. The rotor E then turns within the alternating magnetic field between D, D. Its jerky movement is steadied by a flywheel F, and the large gear G transmits this movement to the rest of the clock.

Clocks Run by Electricity

Some clocks with conventional works are merely *regulated* by electricity, either from batteries or from telegraph circuits. Other electric clocks are run by tiny motors drawing power from a station. The "telechron" clock is an example of the latter variety.

In the latter type, the actual timekeeping is done by the electric current. In order that electric machinery may run smoothly, and for other reasons, power companies keep the cycles of alternating current absolutely uniform, usually at 60 cycles a second. The clock motor using this current therefore runs uniformly, always keeping correct time.

Another marvelously precise clock uses the piezoelectric effect discovered by Pierre Curie in 1880. The effect consists of electric oscillations produced in a quartz crystal by controlled pressure, temperature, and electrical condition (*see* Radio). It is so constant in rate that the clock controlled by such a crystal is expected to maintain an accuracy of within one second in 3,000 years of running.

NATURE'S CHIEF TOOL *and Its* AMAZING POWERS

How the Whole Structure of Our World is Based on the Properties of a Drop of Water—Its Part in Sustaining Life—Harnessing the Streams to Turn the Wheels of Industry

WATER. Here is a good game. Let everyone write down on a sheet of paper (and it should be a large one) every important fact he can think of about water, including its special properties, the things it does, and what it is used for; the winner to be the one with the largest number of correct items in his list.

All the players will, of course, set down rain, snow, hail, ice, and dew, streams, lakes, and oceans, the moisture in the atmosphere and in the soil. They will include also the use of water for drinking, washing, cooking, cooling our refrigerators and gasoline engines, driving our water wheels and turbines, and floating our ships. Many players will probably recall that our bodies are about 70 per cent water and, indeed, that all active living cells and tissue, vegetable and animal alike, must contain a certain amount of water to stay alive. They may add likewise that water is the greatest of all solvents, most of the liquid chemicals used in science, medicine, and industry being water solutions. Some players will know that countless "dry" solids, particularly crystals like borax and washing soda, contain water; and that countless others, such as plaster, bricks, and concrete require water for their formation.

Controls Life and Climate

But how many will realize that if water obeyed the rule, common to most other substances, of contracting when it freezes instead of expanding, life would never have appeared on this earth? And how many will know that it is another exceptional quality of water, its *high specific heat*, which largely controls the climate of our temperate zones and makes them habitable? A thousand other such queries could be made. But one thing is certain about our game; no player will make a perfect score. To sit down and explain all the important facts that are known about water would require several books the size of this one and the author would need to be an expert in virtually every branch of human knowledge.

Why is it that out of the thousands upon thousands of chemical compounds that make up the earth, one of them—a simple combination of hydrogen and oxygen —should play a part so far above all others in importance? The reason is simple. Water is one of the very oldest of all substances. When the earth was forming, as most scientists now believe, from a vast wisp of glowing gas dragged from the sun by the attraction of a passing star, the heat of the mass was at first too great to permit chemical combinations to exist. But, as it cooled, one of the first stable compounds to appear was water in the form of steam.

After the metals and rock-forming elements had changed in the cooling from gases to liquids and from liquids to a solid ball, the time came when the temperature dropped low enough for the steam to condense into a great ocean that filled the earth's hollows. And in all probability the glass of water you draw from the faucet today was a part of that great ocean formed millions of years ago. For very little "new" water is ever formed and very little "old" water destroyed.

It is easy to understand, therefore, since water was "here first," so to speak, why it became one of the supreme rulers of nature. Other and later substances, including all living things, had to be able to "get along" with water or they could not exist.

Performs Earth's Landscaping

Water has been the great architect and sculptor of the earth's crust, entering the cracks of rocks and splitting them apart as it freezes and expands, wearing away mountains by "erosion," rolling the fragments in its torrents to make gravel, sand and clay, carving out valleys and filling them with rich soil, forming the rivers that are the veins of the earth's circulation, washing soluble minerals from the ground and carrying them downstream until the sea contains not only salt but also samples of most of the other earth materials, including even silver and gold.

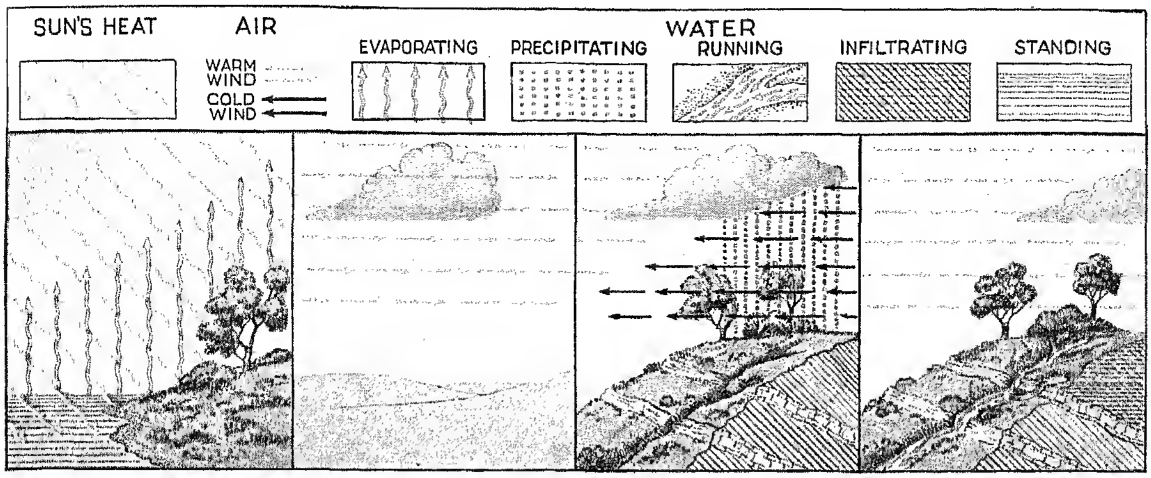
We can think of water also as the chief treasurer and dispenser of the vast wealth of energy that pours down on the earth from the sun. As the sun's rays warm the surface of the sea, water vapor rises. This water vapor first provides the atmosphere with an extra blanket for keeping the earth warm, for it makes up from one to five per cent of the atmosphere; then, as it forms into clouds and passes over the land, it cools and falls again as rain. Rainfall gives us water power and provides the moisture necessary for growing plants, whose roots draw it in along with essential minerals dissolved from the soil. The plants' watery sap rises to the leaves where again it absorbs energy from sunlight and so helps to manufacture the world's food supply (*see* Plant Life; Rainfall).

Reacts Slowly to Heat and Cold

Water requires more heat to warm it and more cold to cool it than any other common substance. That is substantially what we mean when we speak of its high specific heat. For example, it takes five times as many calories to raise a pound of water one degree in temperature as to raise a pound of dry earth one degree, or, to put it in a more practical way, when land and sea are equally exposed to the sun's rays, it takes the sea about five times as long as the land to reach the same temperature, and similarly five times as long to cool off again.

It is evident, then, how the oceans help to control climate. As the heat of summer comes on, they remain cool and send cool breezes over the hot land; but by the end of the season they have accumulated a vast

HOW THE SUN DRIVES THE GREAT WATER-CYCLE ENGINE

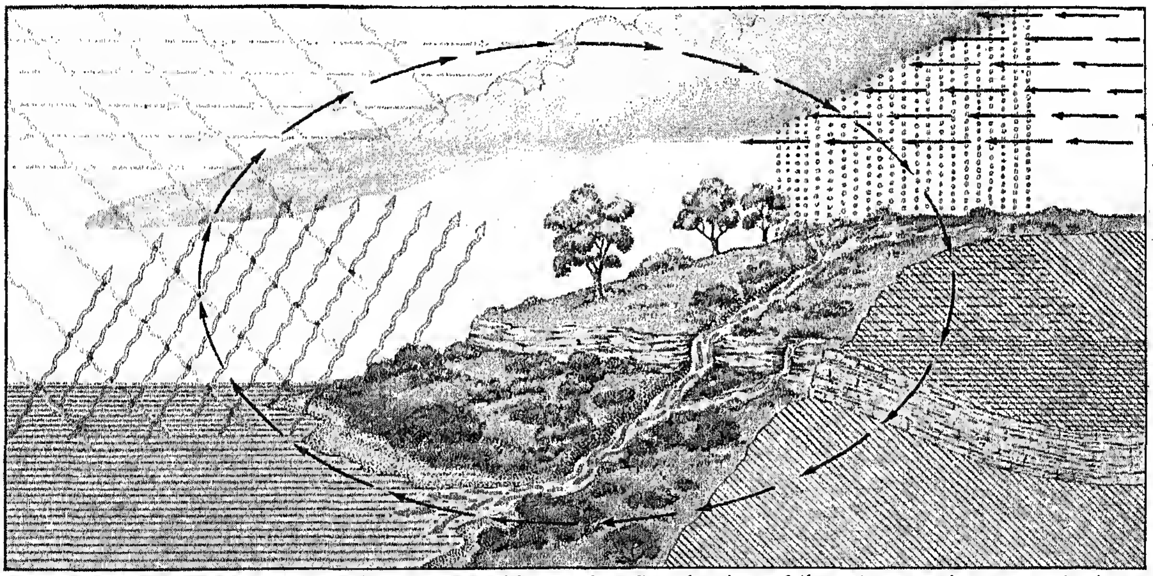


1. The sun's heat evaporates water from the ocean, from moist land, and from plants.

2. Warm winds transport the evaporated moisture as vapor or as clouds over the land.

3. The moist air meets cold winds, and then rain or snow is precipitated upon the earth.

4. Some of the rain water runs off directly into the rivers; some soaks down into the soil.



This picture shows the complete cycle of the great sun-driven engine. Round and round the water goes—from ocean, to air, to earth, and back to ocean. At the right of the picture we see how some of the water infiltrates the soil and descends to the water table (explained in the text). In addition to the surface stream coming down the hill, a spring is shown flowing from the water table.

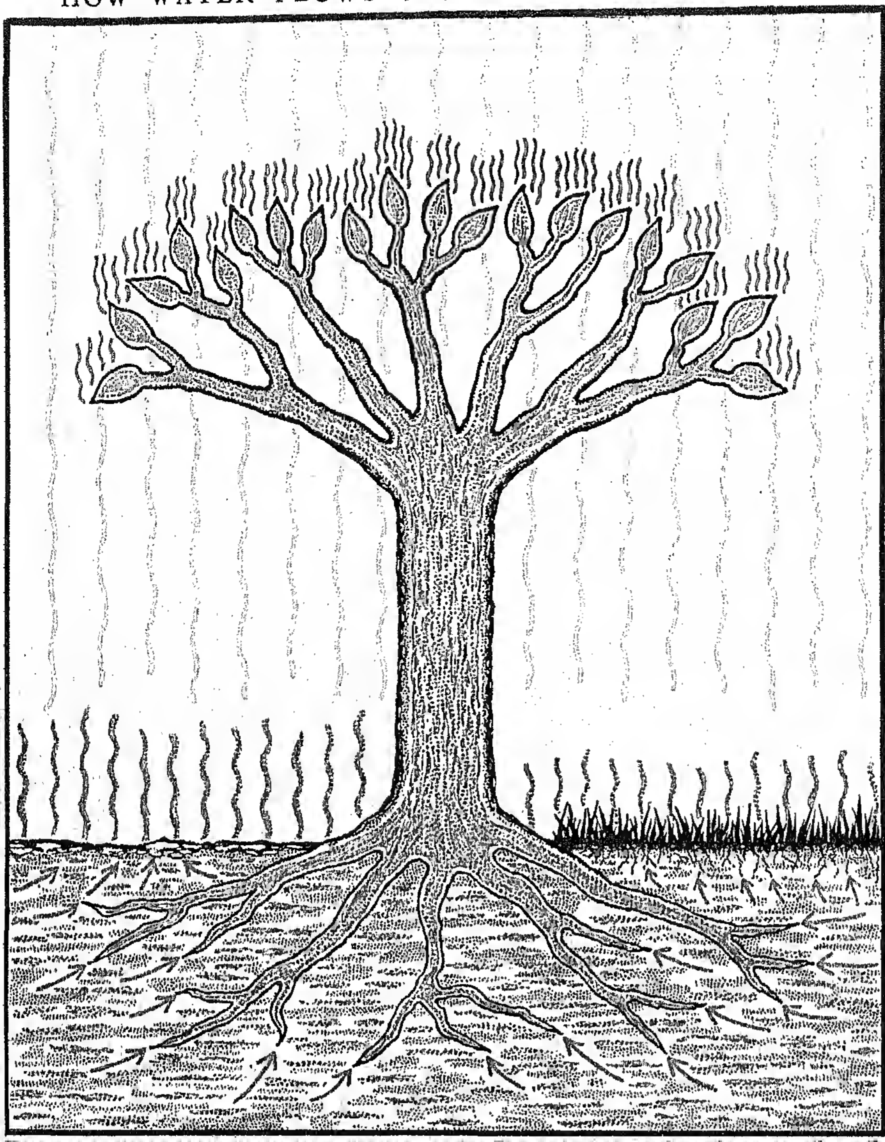
amount of heat which is slowly released again during the winter to moderate the cold atmosphere. Thus it is that the oceans, aided by the shield of moisture in the atmosphere, keep the earth's climate from changing season by season from deadly cold to unbearable heat (*see* Climate). In the same way, the large amount of water in the bodies of men and animals and plants helps to prevent sudden and extreme changes in temperature which otherwise would fatally upset the complicated chemical balance upon which life depends.

Water Movements and the Hydrologic Cycle

Left to itself, water would, of course, settle into the ocean beds and remain there, and the land surfaces of the earth would be lifeless deserts. But, as we have seen, water is being continually lifted out of the oceans by the sun's heat and poured back upon the land as rain and snow. The process that is responsible for the all-important natural movement of water out of the oceans to the land and back to the oceans over and over again is called the *water cycle*, or the *hydrologic cycle*.

Sun, air, water, and the force of gravity work together as if they were interlocking parts of a gigantic engine. The steps in the cycle are illustrated by the pictures on this page. They are (1) *evaporation* of water by the sun's heat, (2) *transportation* of water vapor by winds, (3) *condensation* of water vapor by cold air and its *precipitation* by gravity,

HOW WATER FLOWS UPWARD THROUGH PLANTS



Here we see the part that plants play in the water cycle. The sun's rays are shown in orange, the path of the water in blue. Water enters the tree through the roots and travels up to the leaves. A part of it is used by the tree in making sap. The rest passes out through the leaf pores as vapor (transpiration). At the right we see how grass does the same work on a smaller scale, and at the left how bare ground loses moisture faster than the grass-covered soil.

which are illustrated together, and (4) the *flow-back* of water by gravity to the ocean (*see* Evaporation; Rainfall). When rain or snow falls directly into the ocean, the fourth step is left out. It is also true that water evaporates from rivers, lakes, moist soil, and plants, so that it gets back into the air without first reaching the ocean. But by far the largest part of the water that moves over the face of the earth comes from the sea and returns to the sea.

We have seen that a by-product of this continual flow of water is the erosion of the land by streams. Soil is washed away, as well as the minerals that the water dissolves from the soil. These are not restored when the water returns as vapor. To this extent, and including also the damage done to life and property by floods, the hydrologic cycle is a destructive process (*see* Floods). But, in spite of this, the fact remains that without it there could be no life at all on land.

The "Run-off" and the "Water Table"

The water that falls upon the land divides into three parts. Some evaporates; some (called the *run-off*) flows quickly on or near the surface down to the rivers; some soaks into the ground (*infiltration*) and tends to sink down to what is called the *water table*. This is the underground level where the earth is kept permanently saturated. Springs arise from the water table where gullies or slopes cut down to its level (*see* Spring), and wells are supplied from it. If the soil above the water table dries out, moisture tends to seep upward as if into a blotter. To hold its level the losses of the water table must be balanced by gains of new water from above (*see* Drought).

The picture on this page illustrates the part that plants play in the water cycle. From the damp soil, water passes up through the plant to the leaves, where it evaporates. This is called *transpiration* (*see* Plant Life). Among other effects, transpiration keeps the plant cool. A leaf absorbs about 80 per cent of the radiant energy that falls upon it from the sun. A part of this energy is used in manufacturing plant foods (*photosynthesis*), but most of it is dissipated in causing transpiration. It has been computed that a mature apple tree, with about 100,000 leaves, transpires about 96 gallons of water a day. An acre of apple orchard during the summer would put back into the atmosphere about

480 tons of water each month.

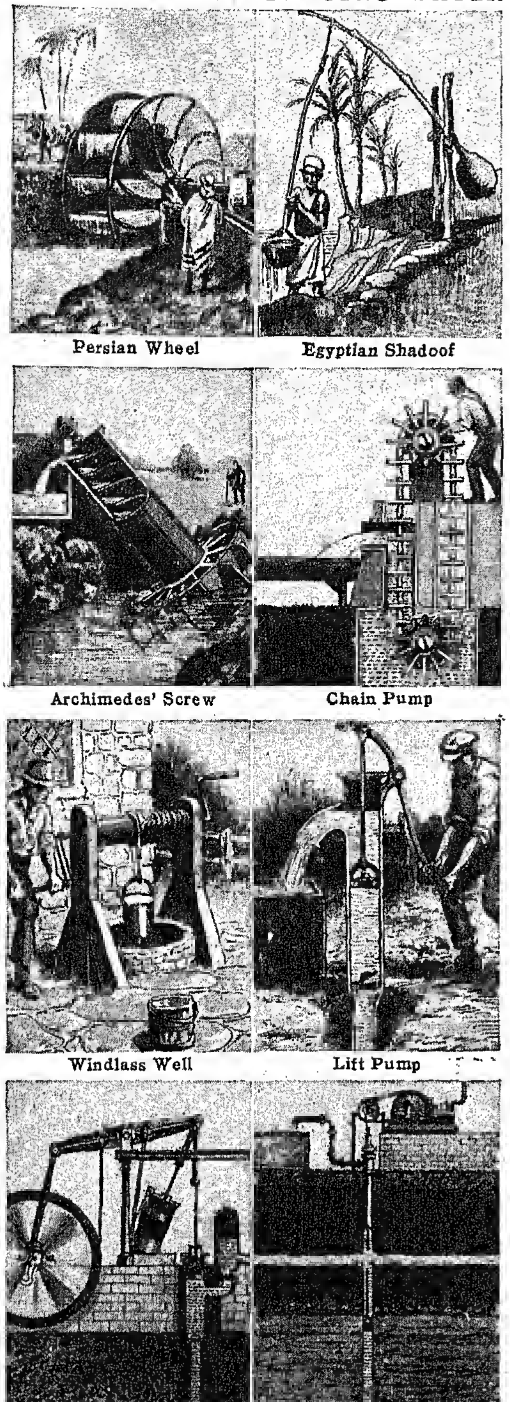
The student of physics is interested in the energy balance of the water cycle. When water turns to vapor, heat energy is absorbed; when the vapor condenses to a liquid again, the same amount of heat energy is released. Thus, one of the effects of the water cycle is to remove heat energy from one place and deliver it to another. Whenever it rains, we may know that cold air is being warmed up among the clouds while evaporation of the rain water on the ground is cooling us off.

Expands When Frozen

The expansion of water when it freezes amounts to about one-tenth of its original volume; one cubic foot of water turns into 1.09 cubic feet of ice. This is what makes ice float, since ice occupies more space than water does, without weighing any more. If water, like most liquids, were heavier when frozen, the oceans would be a solid mass of ice, no rivers would flow, and no life as we know it could exist. When the earth ages ago first cooled sufficiently for ice to form, the ice particles on the water's surface would have sunk to the bottom, gradually uniting and filling up the ocean beds. The sun's summer heat would be barely sufficient, perhaps, to melt a shallow slush on the surface. As it is, the waters of cold climates become covered in freezing weather with relatively thin coatings of ice which thereafter prevent cold from penetrating further to the depths below.

The expansive force of freezing water is enormous. Many a householder finds his water pipes torn open like paper if they have been unprotected on cold winter nights. He may think that heavier pipes would have

EIGHT WAYS OF GETTING WATER



Persian Wheel — Egyptian Shadoof

Archimedes' Screw — Chain Pump

Windlass Well — Lift Pump

Pumping Engine — Deep Well Pump

The Persian wheel was revolved by ox-power, pouring water from its flukes through holes in the hub. The shadoof is an even simpler device. The screw invented by Archimedes was operated by the force of the current. The chain pump consists of a series of pistons working through a pipe. The well with its windlass and the hand pump are largely replaced in progressive countries by power pumps operated by windmills, gasoline engines, or electric motors.

prevented the accident, but he is wrong. If you take a globe of some unyielding metal like cast iron, with sides many inches thick, fill the interior with water, seal it strongly to prevent leakage, and then bring it to ice-forming temperature, the globe will burst open.

Retains Heat

With ordinary atmospheric (sea level) pressure water freezes at 32° F. During the process of turning to ice it remains at this same temperature, but continues meanwhile to give up heat. When the process is reversed and ice is melting, the resulting mixture of ice and water remains at 32° F. until all the ice is gone; by that time the water will have absorbed again the same quantity of heat as it lost when freezing. This definite amount of heat which is alternately given off and absorbed without change of temperature is called the *latent heat of fusion* of water. It represents theoretically the energy difference between the movement of the water molecules when they are arranged in the crystal form of ice and the movement of the same molecules when they are in the liquid arrangement.

As a standard of measure, the latent heat of fusion of any substance is the number of calories absorbed while one gram of the substance is melting. In the case of water it amounts to approximately 80 calories. The use of a mixture of ice and salt in making ice cream illustrates the principle of latent heat. The salt melts the ice rapidly and the mixture absorbs in the process enough heat from the liquid cream to leave it frozen. When we consider what we pay for refrigeration we may sometimes wish that ice would not melt; but if it did not it would not cool our refrigerators. Indeed, we

may regard ice as a kind of blotter that soaks up the heat in our ice boxes and, like an ink blotter, gets all it can hold. (*See also* Freezing; Ice.)

How Water Boils

When we boil water we encounter the *latent heat of vaporization*. If you put a thermometer in your kettle you will notice that the temperature rises rapidly until boiling begins at about 212° F.; and there it remains until all the water has boiled away. Just as when solid water (ice) turns into liquid, so when liquid water turns into vapor (steam), heat is absorbed in the transformation without rise in temperature. The same holds true of other substances when they vaporize. The quantity of heat absorbed at ordinary atmospheric pressure by one gram of water as it turns into steam is about 540 calories.

The effect of higher pressure on water (or any other liquid) is to raise its boiling point. For example, when the gauge of a boiler shows 100 pounds of pressure per square inch, the water inside is above 300° F. The so-called "pressure cookers" occasionally used in households operate on this principle. Their steam-tight lids permit food to be boiled or steamed with more intense heat than can be obtained in an open vessel.

Lowering the pressure, on the other hand, lowers the boiling point. This is often desirable as, for instance, in making sugar or evaporated milk. These would be spoiled by cooking; so they are heated in vacuum pans where the moisture boils away at about 160° F. On very high mountains the lower atmospheric pressure decreases the boiling point to such an extent that eggs cannot be boiled satisfactorily.

What Causes Evaporation?

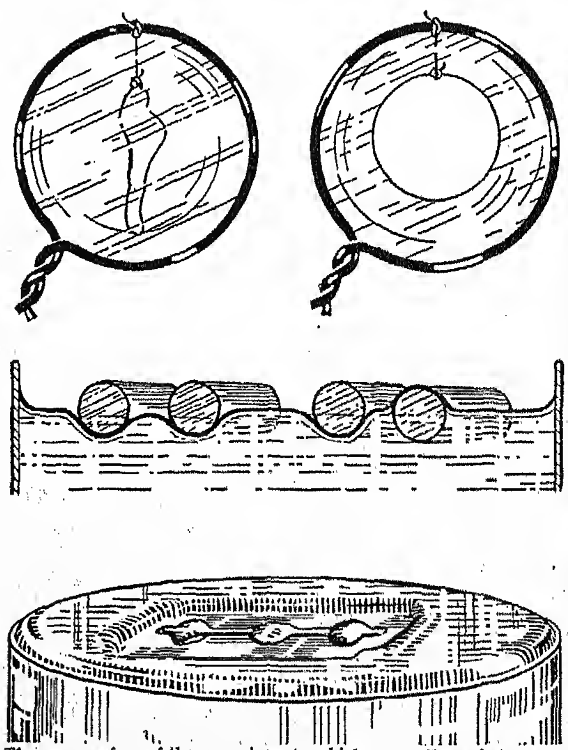
What is the difference between evaporation and boiling? It is largely a question of the speed of action. The heat of a substance, as we know, depends on the rapidity of motion of its molecules (*see* Heat; Physics). At ordinary temperatures and pressures the motion of most of the molecules in a vessel of water is not sufficient to overcome their mutual attraction; they cling together in the liquid state. But some of them at the very surface, what with their own motion and that of their neighbors, get bumped out into the air and wander away. This tendency of water to throw off molecules from its surface causes ordinary evaporation (*see* Evaporation). It is shared by all liquids in different degrees. Those like alcohol and ether which evaporate more rapidly than water are said to be *volatile*. Evaporation proceeds more rapidly as the temperature rises, because of the increased activity of the molecules. Sooner or later a point is reached where not only the surface molecules but also those down inside the liquid move so violently that they break away from close association with their neighbors and form bubbles of vapor which rise to the surface and escape. This is the *boiling point*.

Pressure on a liquid raises its boiling point because the vapor pressure inside the bubbles has to equal the pressure from without before the bubbles can form at all. The force of this vapor pressure depends, of course, upon the activity (temperature) of the molecules composing it. At ordinary atmospheric pressure, a cubic foot of water will when boiled away produce about 1,600 cubic feet of steam.

If two equal amounts of water turn to vapor, one slowly by ordinary evaporation and the other rapidly by boiling, the quantity of heat absorbed by each is in the end virtually the same. In the absence of a flame or other artificial source, the evaporating water draws heat from its general surroundings, making them in consequence cooler. A soldier on the march wets his felt-covered canteen in a roadside ditch so that the evaporating moisture will make his drink cool (*see also* Evaporation; Refrigeration).

Water reaches its greatest density at 4° Centigrade (39.2° F.) and at this temperature it is used as the standard of comparison for the specific gravity or relative weight of all other substances (*see* Gravitation; Physics). Below that point it begins to expand in the

PLAYING TRICKS WITH SURFACE TENSION

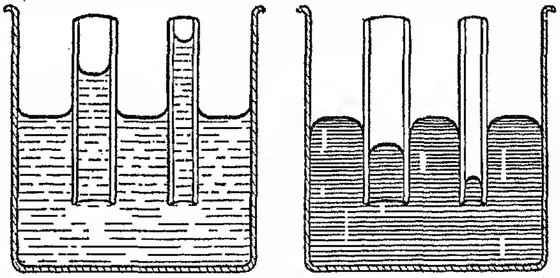


These are a few of the experiments which prove the existence of a clinging "skin" formed by molecular attraction from within the water as the text explains, on the surface of water and other liquids. The topmost experiment shows how this "skin" tends to contract. Hang a loop of thread in a wire disk, then fill the disk with a film of soapy water. Now strike a pin through the film inside the loop, and the loop will snap into a perfect circle, as the right-hand picture shows. The contractile force of surface tension on the two faces of the film outside the loop does this the moment the pin breaks the film inside the loop. At the left of the center picture two greasy rods are floating on the surface of a bowl of water. The water surface tends to flatten out, just as a thin elastic skin would do, and the rods will come together. At the right are a greasy rod and a clean rod. The latter is "wet" by the water, while the former is not. As the water surface tries to flatten out, the rods are driven apart. Below, a safety razor blade is floating on the surface of a glass full of water, supported by surface tension. If the blade was free from oil so that water could wet it, it would sink.

process of freezing; above that point it expands gradually to the boiling point. For most practical purposes the weight of water is taken to be 62.4 pounds per cubic foot. As we measure downward from the surface of a body of water, the increasing pressure due to this weight amounts to $4\frac{1}{3}$ pounds per square inch for each 10 feet of depth. At this rate the pressure a mile down in the ocean reaches somewhat more than $1\frac{1}{8}$ *tons* to the square inch. The salinity (saltiness) of sea water, while it varies in different parts of the world, averages about 35 pounds of salts in each 1,000 pounds of water, which makes it about 2.5 per cent heavier than pure water. (*See also* Diving; Ocean.)

Liquid water can be compressed only to a very slight degree, so little indeed that for most practical purposes it is considered incompressible. This quality is turned to many important technical uses (*see* Hydraulic Machinery). Salt water compresses more than fresh.

TWO RESULTS OF CAPILLARITY



At the left we see how capillary attraction, acting as explained in the text, draws water upward inside small tubes. The right-hand picture shows the reverse action, which takes place whenever the liquid used will not wet the tube—that is, when there is no adhesive force between the liquid and tube, as is the case with a glass tube dipped in mercury. Since the liquid in the tube is cut off by the tube from all sidewise pull toward the tube, its top surface rounds off, as though it were going to form into a droplet. The contractile force of the "skin" then forces the liquid down until this force is balanced by the upward thrust from the liquid standing at a higher level outside the tube. Each of the curved surfaces formed in this way is callsd a meniscus.

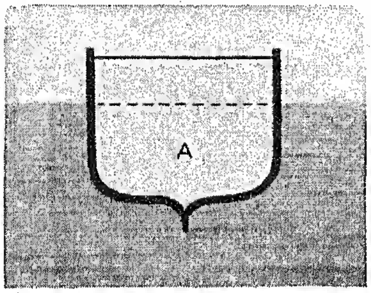
Surface Tension of Water

Water illustrates plainly another interesting quality common to all liquids. Take a safety razor blade of the thin two-edged variety and after making sure that it is thoroughly dry lay it gently on the surface of a glass full of water. It will float. Now, if you look carefully, you will see that the blade is actually lying in a hollow in the water surface. The sides of the hollow have a sharp upward curve from the blade's rim and through the holes in the middle of the blado project tiny convex water lenses. It looks as if the top of the water were covered with a thin elastic skin which stretches but refuses to break under the weight of the steel wafer. And indeed that is precisely what you have thero—a kind of skin produced by what is called *surface tension*.

We saw in the case of evaporation that the surface molecules require an extra push to be driven off; most of them are drawn downward by those beneath the surface, and, since there are no other water molecules above to offset this downward pull, they are packed together more densely than thoso elsewhere in the glass. The "skin" so formed has, as we see, considerable resistance; for one thing, it forms the water in clouds into raindrops. Unless forcibly broken, this "skin" persists until it encounters a substance which has a greater attraction (called *adhesion*) for water molecules than water molecules have for each other (*cohesion*). Clean glass is such a substance. You will probably notice that the water surface slopes up in a sharp curve where it meets the sides of your tumbler.

When we say that water *wets* glass, plain wood, or ordinary cloth but that it does not wet hard rubber, oilcloth, or any greasy substance, we are stating in popular language that the surface tension of water is *less* than the force of adhesion between water and glass, but greater than that between water and oilcloth. This explains, for example, why water forms in drops on oilcloth.

ARCHIMEDES' RULE



Here a ship, shown in cross-section, is displacing water (A) exactly equal to it in weight. It must do this, since the surrounding water will support either the displaced water or the ship, and the ship must sink until the weights are equal.

Surface tension explains many facts of the kind illustrated in the accompanying pictures. (*See also* Soap Bubbles.) But perhaps its most striking effect is what science calls *capillarity*. If you dip the end of a small glass tube into water, the water will rise in the tube above the surrounding level. What happens is plain. The water, as we have seen, wets the glass and hence tends to climb up the sides of the tube, both outside and inside. But on the inside the water surface is so small that the curve its rim makes in climbing the glass tends to extend to the center of the tube. But since this curved surface is under elastic tension, it naturally tries to flatten out and, in so doing, lifts its center higher. This relieves the surface tension somewhat, whereupon the rim climbs further up the glass. This continues until the weight of the water lifted balances the upward pull of the contracting surface. The smaller the bore of the tube the higher, of course, the water will go. (*See* Capillary Attraction.)

Impurities of Water

Natural water is never pure. So great is water's solvent action that even the raindrops take impurities from the air as they fall. Water that passes through the soil always contains dissolved minerals. These are sometimes of the kind that makes the water "hard" so that it fails to lather properly with soap.

By boiling water we kill any germs it may contain; likewise the filtering and treatment that goes on in modern water plants gives us safe drinking water (*see* Waterworks). But to obtain water of sufficient purity for delicate chemical processes, it is necessary to distil it (*see* Distillation).

The "impurities" in the water from certain springs really are salts considered beneficial to health, and noted resorts grow up around some of these springs (*see* Spring). The United States alone has some 10,000 known mineral springs, and bottling spring water is an important industry.

"Soda water," widely used in the soft drink industry, is water charged with carbon dioxide. At soda fountains, the gas is released from containers to mix with the water; in making bottled soft drinks, the gas is forced in at the factory.

The chemical formula for water is H_2O, meaning two atoms of hydrogen and one of oxygen. Since 1931, however, science has known that the hydrogen may be of either "ordinary" or "double" weight (*see* Hydrogen), and "triple weight" hydrogen has been known since 1934. "Heavy water" with double-weight hydrogen is known as *deuterium oxide* (D_2O). One part of heavy water is found in from 5,000 to 6,000 parts of ordinary water. It can be separated by evaporation, or better by electrolysis, since it reacts more slowly than the lighter kind. It differs markedly from ordinary water in its effect on living beings.

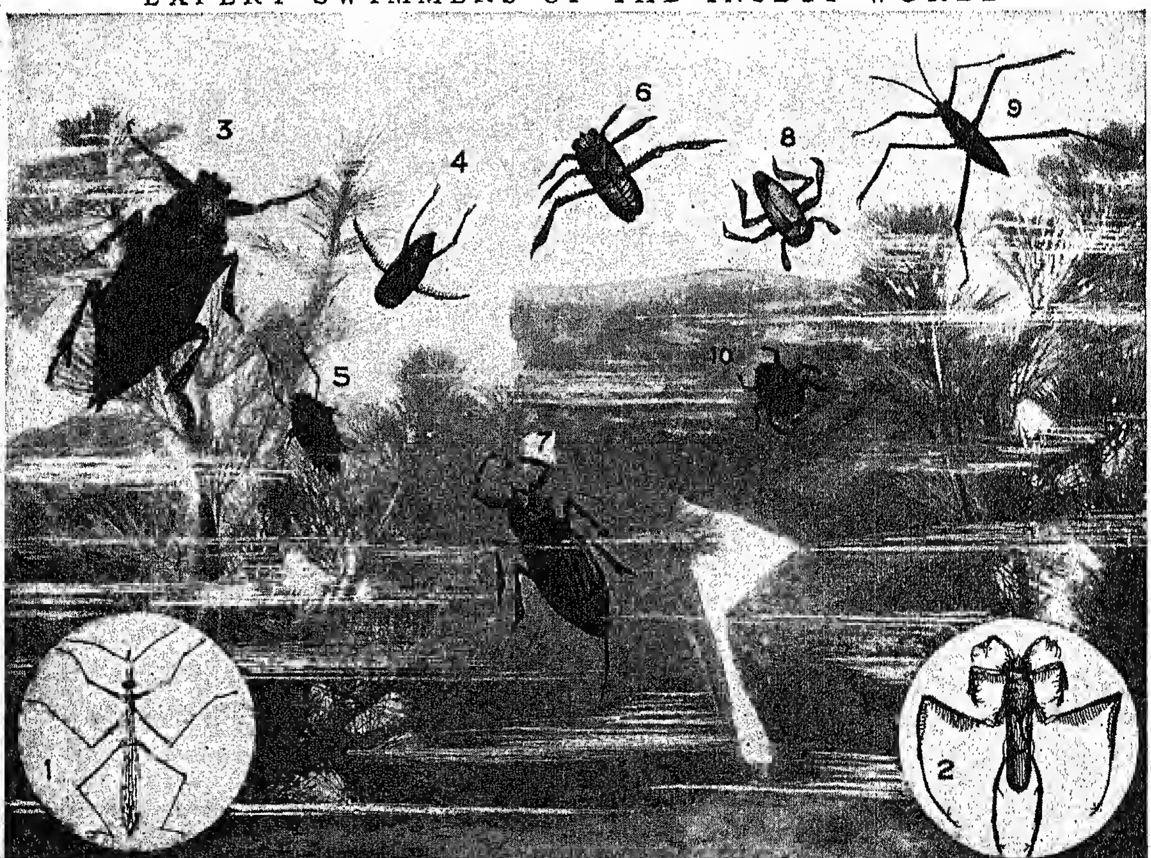
Scientific terms containing "hydr–," such as *hydrate, hydride,* and *hydroxide,* indicate relationship to water (from the Greek *hydor,* water). *Anhydride* and *dehydrated* indicate that the water normally present in a substance has been removed. Water usually is formed when a substance containing hydrogen is burned in the presence of oxygen. The easiest way of separating it into its elements is by electrolysis, as shown in the picture on the first page of the Chemistry article (*see also* Electrolysis).

WATER-BUGS. This is a common name given to several kinds of insects which live in streams or ponds. They belong to a large group known as the *Hemiptera,* or true bugs, which have beaks for piercing and sucking. If you hold one tightly it may give a painful jab.

The water boatman is one of the familiar varieties. This is an oval-shaped gray-and-black mottled bug, with one pair of its legs very long and fringed with hairs. These two legs project out from the boat-shaped body like oars and row the insect along.

The back-swimmer is shaped something like the water boatman, with a sharper hind end. This curious creature always rows himself through the water upside down, with his stomach uppermost. That is why he is called back-swimmer. He hangs from the surface by the top of his abdomen, where there are hairs arranged in bunches. One beautiful and very common species of back-swimmer has a handsome glistening white back and two brilliant red eyes.

EXPERT SWIMMERS OF THE INSECT WORLD



You have only to watch the still waters of any pond to see all sorts of gymnastic performances by the many bugs which live in such quiet waters. All of the water-bugs shown here are common in most parts of the United States. Two of them (1 and 2) are enlarged, as they would appear under a magnifying glass; all of the others are slightly smaller than natural size. 1. Marsh-Treader. 2. Riley's Water-Strider. 3. Giant Water-Bug. 4. Water Boatman or Water Cicada. 5. Black Whirligig. 6. Back-Swimmer (from below). 7. Water-Scorpion. 8. Another kind of Water Boatman. 9. Water-Strider. 10. Creeping Water-Bug.

The water-scorpion is a long brown creature, with long spindling legs and awkward movements. It lives on the bottom of ponds amid pieces of stems, etc., which it resembles. For this reason it is sometimes called the water-stick. It is a very fierce creature and catches and sucks the blood of all sorts of insects.

The giant water-bug, or electric-light bug, is the largest, as well as the one most to be feared by small fish and other inhabitants of ponds and streams. It is about two inches in length, and is oval in shape, brownish, and with a long beak and big eyes. Like the June bug, which is really a beetle, these creatures can often be found on summer nights crawling underneath electric lights on street corners or dashing into the light to their death.

The creeping water-bugs are little roundish creatures that may be found crawling over the bottom of ponds looking for other insects upon which to feed. Often they come out and crawl along the grassy shores.

The Nimble "Water-Striders"

The water-skater, or water-strider as it is sometimes called, has a long narrow body and six spidery legs by which it darts over the surface of the water with hardly a ripple. The middle pair act like rapidly moving oars, while the hind pair are used to steer. The short legs in front rest lightly on the water, ready to shoot out and seize any unsuspecting insect that comes within reach.

Water-bugs of all sorts are easily caught and make interesting pets in an aquarium. The big electric-light bug should never be put in with small fish or frogs, for it will attach itself to them and kill them by sucking their blood.

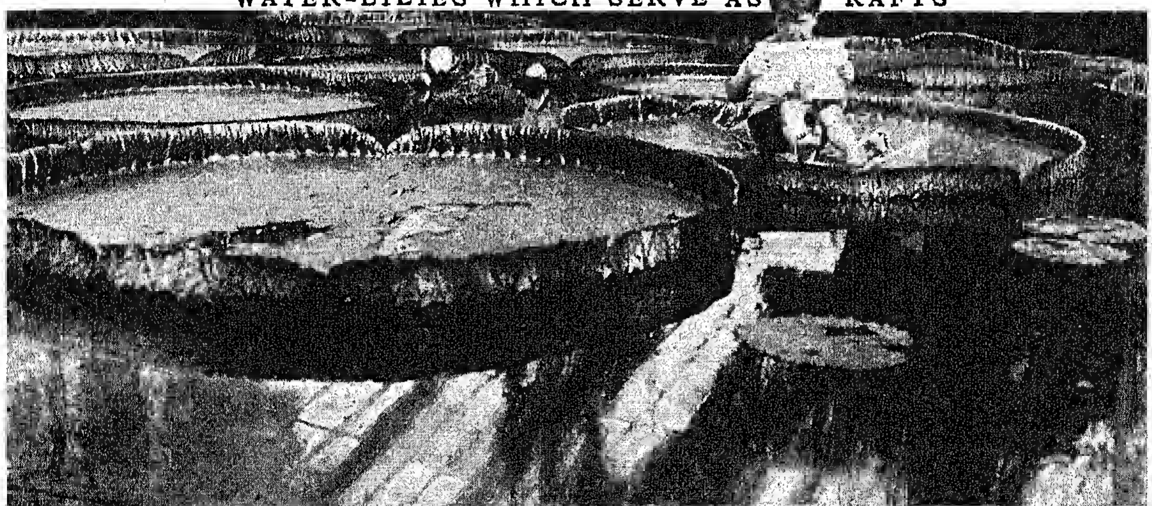
The scientific names of two common species of water boatman are *Notonecta undulata* and *Notonecta glauca;* common form of water-scorpion, *Nepa cinerea;* of water-strider, *Hydrotrechus remigis.* The electric-light bugs are known as *Belostomidae.* In addition to the species described in this article, there are a number of water-beetles to which the name "water-bug" is sometimes applied (*see* Beetles).

WATER-LILY. A pretty Indian legend holds that the water-lily was once a star which fell from its place in the azure sky and striking upon the water was changed into a flower. This "queen of the water" finds its home in the waters along the border of lakes, in quiet shallow places where the soil is rich. The thick stems make their way to the surface, adjusting themselves to the water's depth and serving as anchors for the flowers which majestically float in their field of flat waxy-green leaves. The blossoms usually open and close at dawn and sunset, and their life is about three days; but some expand in the evening only, others close soon after noon, and still other varieties remain open throughout the day. The seed-pod ripens beneath the water, dropping its seeds on the loamy bottom. The exquisite flowers may be found from June until September ranging from Nova Scotia to the Gulf of Mexico, and westward to the Mississippi.

Among the water-lilies belongs the gigantic *Victoria regia* of the Amazon, with enormous white flowers, and leaves so broad and firm that they are capable of bearing the weight of a child. On the under side and around the upturned edges, the leaves are coated with spiny points. Snails and water-bugs may be found clinging to this thorny retreat, in hiding from the fish which prey upon them. Brazilian ostriches, spoonbills, and stilt-plovers, wading birds of the Amazon, frequently perch upon the upper surfaces.

There are various other species of this beautiful group of plants distributed throughout the world, ranging in color through white, pink, and yellow to

WATER-LILIES WHICH SERVE AS RAFTS



This giant among Water-Lilies, the *Victoria regia,* has flat leaves 6 to 7 feet in diameter, with rims from 4 to 6 inches high. The upper surface of the leaves is bright green, the under side a vivid crimson. The flowers, which vary from 8 to 16 inches across, shade in color from a delicate rose or pink to pure white. The plant is a native of the Amazon valley, where it grows in sluggish or stagnant waters, often covering the surface solidly for miles. Specimens are successfully grown in botanical gardens. One of the vari-colored lily pads serves here as a novel raft. A piece of rigid material laid on top of the leaf distributes the weight of the boy over the surface of his odd craft and prevents him from breaking through and getting a ducking.

blue. Our present-day water-gardens contain water-lilies assembled from all parts of the world; and many hybrids have been bred combining loveliness of form and color with hardiness.

Scientific name of the water-lily family, *Nymphaeacea*. The sweet-scented white water-lily is *Nymphaea odorata;* the yellow pond-lily, cow-lily, or spatterdock, *Nuphar advenum.* The Egyptian lotus is a closely related species belonging to the genus *Nymphaea*. The American and East Indian lotuses belong to the genus *Nelumbo* (*see* Lotus).

WATERLOO, BATTLE OF. The history of Europe might have been very different if it had not rained in Flanders on the night of June 17, 1815. At daybreak on the 18th, Napoleon, mounted on his white horse, was scanning the battlefield of Waterloo, but it was nearly noon before the mud was dry enough for the artillery to advance. Meanwhile the Prussians, who had been defeated two days before at Ligny, were slowly but none the less surely making their way through the muddy roads to the aid of the British.

Only three months before, Napoleon had slipped away from his island prison of Elba, off the coast of Italy. When he returned to France his old soldiers had flocked to his standard. He had hurried north with his army, hoping to defeat his quarreling enemies before they had a chance to unite. His plan seemed successful. He got between the English, who were concentrated in the vicinity of Brussels, and the Prussians, who were cast of the road from Brussels to Charleroi. On the 16th Ney held the English engaged at Quatre Bras, while Napoleon crushed—as he thought—Blücher's Prussians at Ligny. After the battles he left Grouchy with orders to follow Blücher, and turned his attention to the English. Blücher, however, drew off to the north and marched to the assistance of the British, while Grouchy wasted precious time searching for him to the east of Ligny.

The British meanwhile retreated to the little Belgian village of Waterloo, nine miles southeast of Brussels. Napoleon overtook them late on the 17th, but could not attack until the following morning. After delaying until 11 o'clock he gave orders to advance. For ten hours the battle raged, Napoleon repeatedly hurling his columns of cavalry against the stubborn squares of the bayonet-wielding British infantry. For a time it seemed as though the ranks must give way before the terrible onslaught, and the Duke of Wellington, the British general, anxiously awaited the promised Prussian aid. Finally, late in the afternoon, Blücher's men arrived. Those hours that Napoleon had waited that morning saved the day for his enemies. The French made their last desperate attack, but were slowly overborne. By nine in the evening their defeat was a complete rout. Seven times their flying forces were halted for the night, but each time they were driven onward. So desperate was the fighting that the combined losses were more than 50,000.

Napoleon's defeat was decisive. In Paris four days later he signed his second abdication, ending his power forever. (*See* Napoleon I.)

WATER-PLANTS. The enormous group of plants that live in or on the water is remarkable for the various ways in which its members have adapted themselves to such a life. Those that live wholly under water, supported thereby in quiet depths, have no wood or "bast" to stiffen them, but those in running water are tougher. Another common adaptation is the development of conspicuous air passages, such as you see in the stalks of water-lilies, caladiums, etc. It is necessary for air to be brought into the plant and carried to parts which are too much shut off from air by water.

The roots in most cases are much reduced, and in some cases they have disappeared entirely. Where they exist, they serve chiefly as anchors, not for extracting food from the mud. The air cavities would hoist the plant from its position were it not securely fastened. Many water-plants, however, do float bodily throughout their existence. Common duckweeds in myriads form sheets of green scum on stagnant ditches. They are extremely tiny, but the similar water-hyacinth is large; its huge rosettes drift together in wide rafts under spikes of azure flowers buoyed up by their hollow swollen petioles, and in southern bayous they seriously obstruct the passage of even large boats. Gulfweeds and other kinds of seaweed are kept afloat by numbers of little globular air-bladders.

The leaves too show interesting adaptations. Submerged leaves have no "stomata" or breathing pores. Frequently the leaves are very finely divided, especially in running water, thus presenting less resistance to the water and objects borne along in it. The many slender long leaves also present a larger surface to the water whence they draw their nourishment. Some have no submerged leaves at all. The leaves that float, such as the "pads" of water-lilies, are usually thin and flat, round or oval in shape, supplied with air-filled cavities for buoyancy, and with flexible slender stems, long enough to allow for changes in water level. They have breathing stomata on the upper surface. They are often purplish beneath, this color being due to a chemical within the cells which has the power of changing light rays into heat—an advantage in a cool stream.

The reproduction of some under-water plants differs from that of land-plants. Some bear spores, or both flowers and fruits, beneath the surface, where the pollen floats away to other plants; but most of them have devices for blooming at or above the surface, the flowers either floating on the water, or, more usually, poised on stems reaching above it. The tape grass sends its staminate (pollen-producing) flowers adrift to collide with the stationary pistillate ones, and thus transfers the pollen from the one sex to the other. But with water-plants as with land-plants, insects and breezes are the usual pollen carriers.

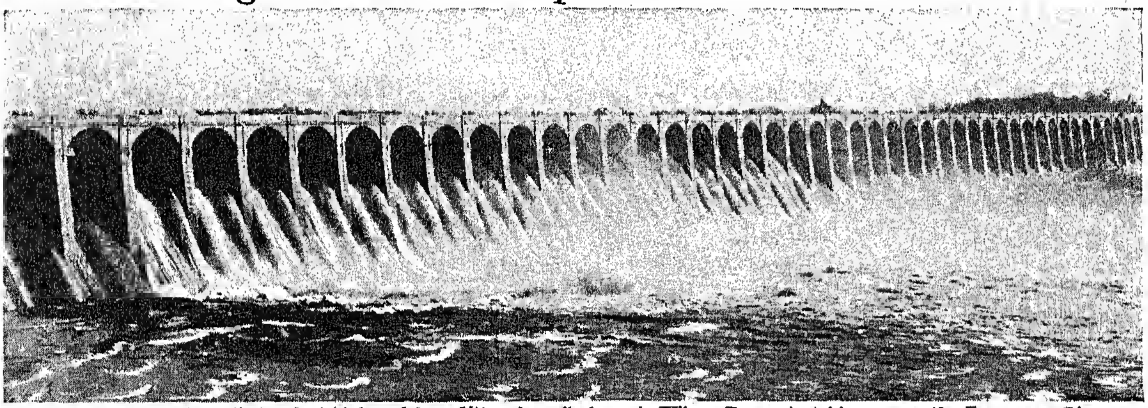
Various water-plants have seeds or fruits provided with buoyant envelopes, so that when they ripen and fall on the water they can sail before the wind or

ride on the current. The seeds of water-lilies are embedded in fleshy pods which, when decayed, form a slimy mass from which waterfowl pick out the fruits to eat, thus carrying seeds on their smeared bills to other districts. Seeds and even tiny plants are also carried at times, stuck on the muddy feet or the plumage of waterfowl.

As a result of the variety of modes of dispersal, and of the ease of dispersal by the water itself, together with the uniformity of conditions of life in the water, certain water-plants are thought to have a wider distribution than any other kind of plant.

There are three conspicuous types of water-plants, or *hydrophytes*, to use the scientific name. The first type is made up of the "free floating societies," that is, those in which the plants are entirely sustained by water and are free to move either by locomotion or water currents. To this group belong the ordinary pond societies, composed of algae, duckweeds, etc., which float in stagnant or slow-moving water. The second type is made up of the "pondweed societies," in which the plants are anchored, but their bodies are submerged or floating. Here belong the associations of seaweeds, among which there are often elaborate systems of holdfasts. Another conspicuous pondweed society is that which contains among its representatives the water-lilies with their broad floating leaves and the pondweeds or pickerel weeds with entirely submerged leaves. The third type is made up of "swamp societies," in which the plants are rooted in water or in soil rich in water, but the leaf-bearing stems rise above the surface. The conspicuous swamp societies are "reed swamps," characterized by tall rushes, cat-tails, and reed grasses; wandlike monocotyledons which usually form a fringe about shallow margins of small lakes and ponds; "swamp moors," the ordinary swamps, bogs, marshes, etc., which are covered by coarse grass; "swamp thickets," in which there is a tangle of willows, alders, etc., "sphagnum moors," in which the sphagnum moss prevails and is accompanied by numerous orchids, heaths, etc.; "swamp forests," in which the tamarack (larch), spruce, pine, hemlock, and juniper are the prevailing trees.

Harnessing WATER *to Help with the* WORLD'S WORK



This great concrete wall, 137 feet high and four-fifths of a mile long, is Wilson Dam, stretching across the Tennessee River at Muscle Shoals, near Florence and Sheffield, Ala. It cost $46,000,000 and stores enough water to furnish 600,000 horse-power of hydroelectric energy. The spillway section, above, has 58 steel gates through which water pours at the rate of nearly a million cubic feet a second.

WATER POWER. When we put waterfalls and streams to work, we are really harnessing the two oldest forces in our world—the heat of the sun and the pull of gravity. Like the winding up of a clock a million years old, the sun continually draws up from oceans and lakes moisture that is carried across the land by winds. And when this water vapor turns to rain it falls and flows back again to lake and ocean, drawn by gravity, like the unwinding of the clock's gigantic spring.

This great source of power seems to have been first used by the Egyptians, who set up simple wheels to raise water from the Nile for irrigation. Wheels of this type may still be seen along the muddy banks of that river. The Chinese used water motors; and we know that several centuries before Christ the Greeks experimented with crude hydraulic machinery.

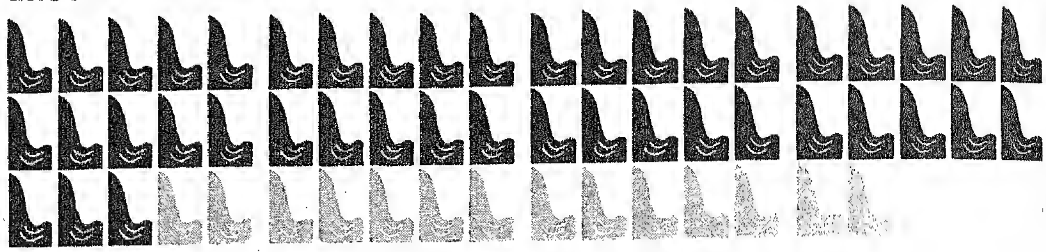
So far as we know the American Indian made no use of water power, but the Pilgrims, as early as 1628, began to harness water power for grinding corn, and soon they were using it for sawmills and in small factories. Later on in New England many great industries were built up around the water-mill sites.

As civilization moved westward and immense coal deposits were discovered in Pennsylvania, steam power became paramount, and for a time water power was neglected. The rebirth of interest in it came with the commercial use of electric power (*see* Electric Light and Power). The first hydroelectric station in America was built at Appleton, Wis., in 1882.

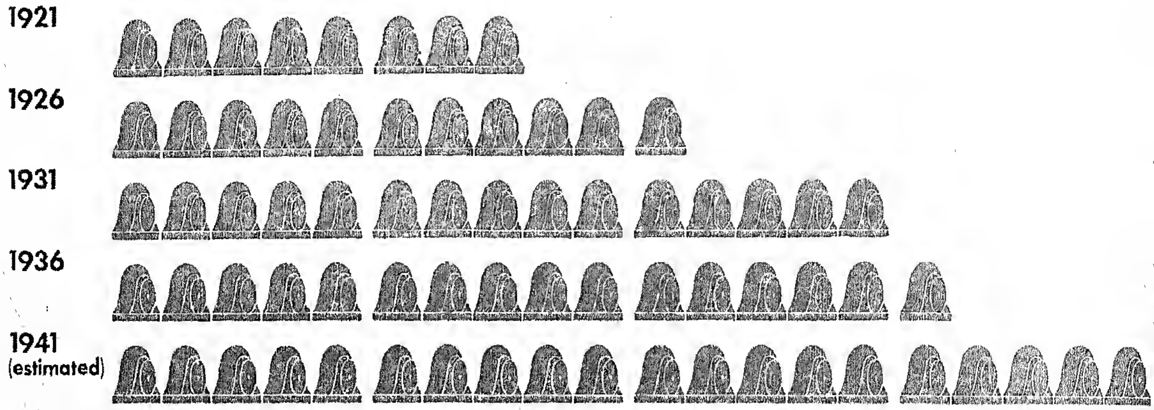
Today the United States leads all other nations in water-power development. About 43 million horse-power is available for development in the United States at the usual minimum flow of the rivers. By

Water Power in the United States

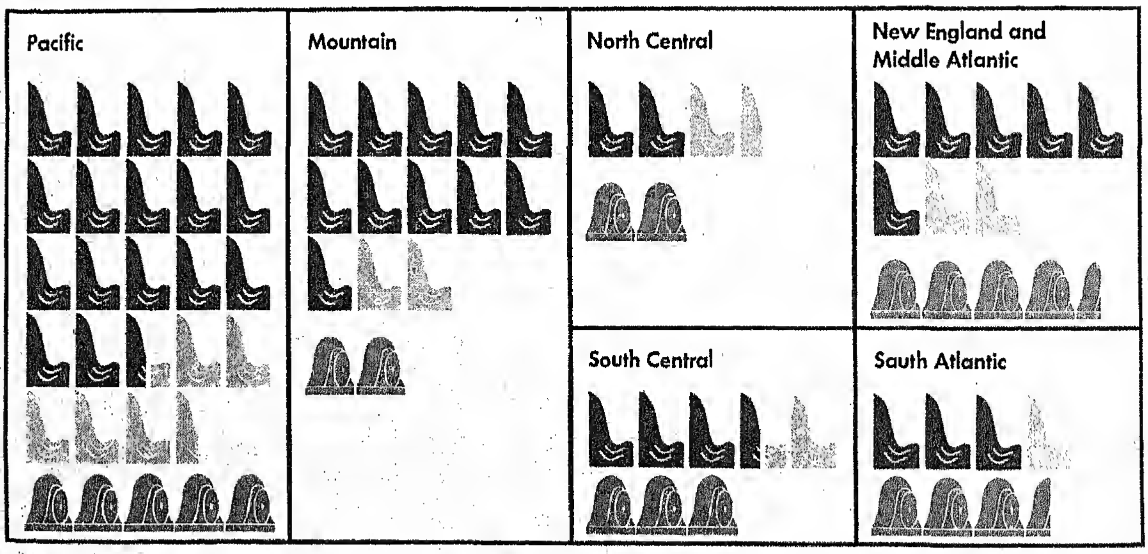
Total Amount Available



Total Amount Developed



Available and Developed Power by Regions



Each complete symbol represents 1 million horse-power
dark blue: power available 90 % of the time
light blue: additional power available only 50 % of the time

Prepared for Compton's Pictured Encyclopedia

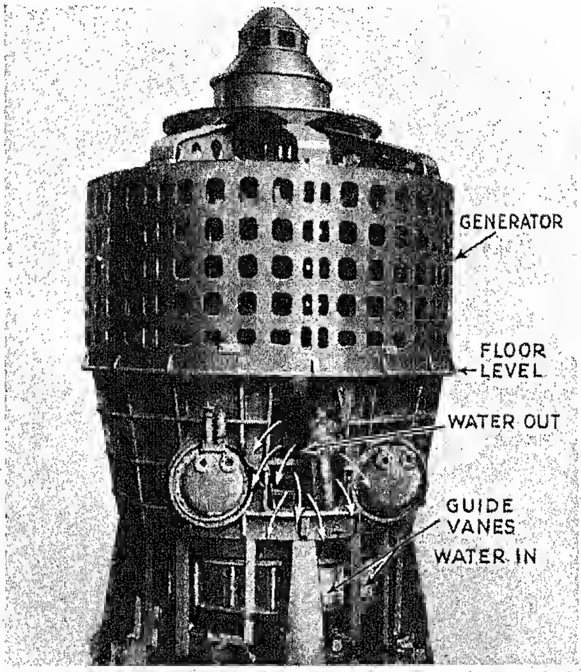
The water power available in the United States is 43 million h.p. in seasons of low water, with 14 million additional h.p. in months of strong flow. Developed horse-power cannot be directly compared with the amount available, because the former represents capacity of turbines installed. This capacity may exceed the power which is available 90 per cent of the time. Engineers estimate that a total installed capacity of 80 million h.p. would be needed to harness the 57 million h.p. available.

harnessing the water which flows as much as half the time, 14 million more horse-power can be developed. The sum of these figures is commonly called *potential* power, although much of it has been harnessed. The figures allow for a 30 per cent loss in the power plants. The country now has installed plants capable of developing about 19 million horse-power. On the same basis, Canada has about 29½ million horse-power available. A capacity of 8 million horse-power has been installed. The Belgian Congo, including the Belgian Mandate, has about 90 million horse-power available at low water; but little of it has been harnessed.

The United States passed the Federal Water Power Act in 1920. The act provides for government ownership and control of the nation's water-power sites, but allows private interests to lease them.

The advantages of water power—"white coal," it is often called—seem so obvious that failure to develop it may seem like letting wealth flow away. Much of it, however, cannot be used at present. While about 65 per cent of the nation's water-power resources is in the Rocky Mountain and Pacific region, more than 70 per cent of the nation's power demands is in the northeastern part of the country, and there is no immediate way of bringing the two together.

A HYDRAULIC TURBINE INSTALLATION



A typical hydroelectric unit of 37,500 horse-power, photographed during construction. Water enters the turbine through the vanes at the bottom and leaves by a number of ports like the one where the man is standing.

If all the water power available east of the Mississippi were fully developed, it would supply only about two-fifths of the present power requirements there; while if the same thing were done in the Pacific coast region, there would be no market for much of the power generated.

A water-power plant usually demands a larger initial investment of capital in proportion to the amount of power obtained than a steam plant. When a dam is to be constructed, a survey of the site must be taken, borings and tests must be made, titles to the lands that will be flooded by the backed-up water must be acquired, and the legal and safety requirements of the Federal Power Commission fulfilled. For a certain 200,000 horse-power plant on the Colorado River, over $100,000 was spent on this preliminary work alone. At the site of the Wilson Dam at Muscle Shoals, some six miles of exploration holes were drilled and tested with compressed air to make sure that the rock foundation for the dam was safe.

In South Carolina is the Saluda Dam, considered a work of moderate size by engineers. It converted a river into a lake of 750 billion gallons of water, with a shore line measuring 520 miles. It took 11 million cubic yards of earth (a cubic yard is about an ordinary cart load) and 122,000 tons of gravel to build this dam.

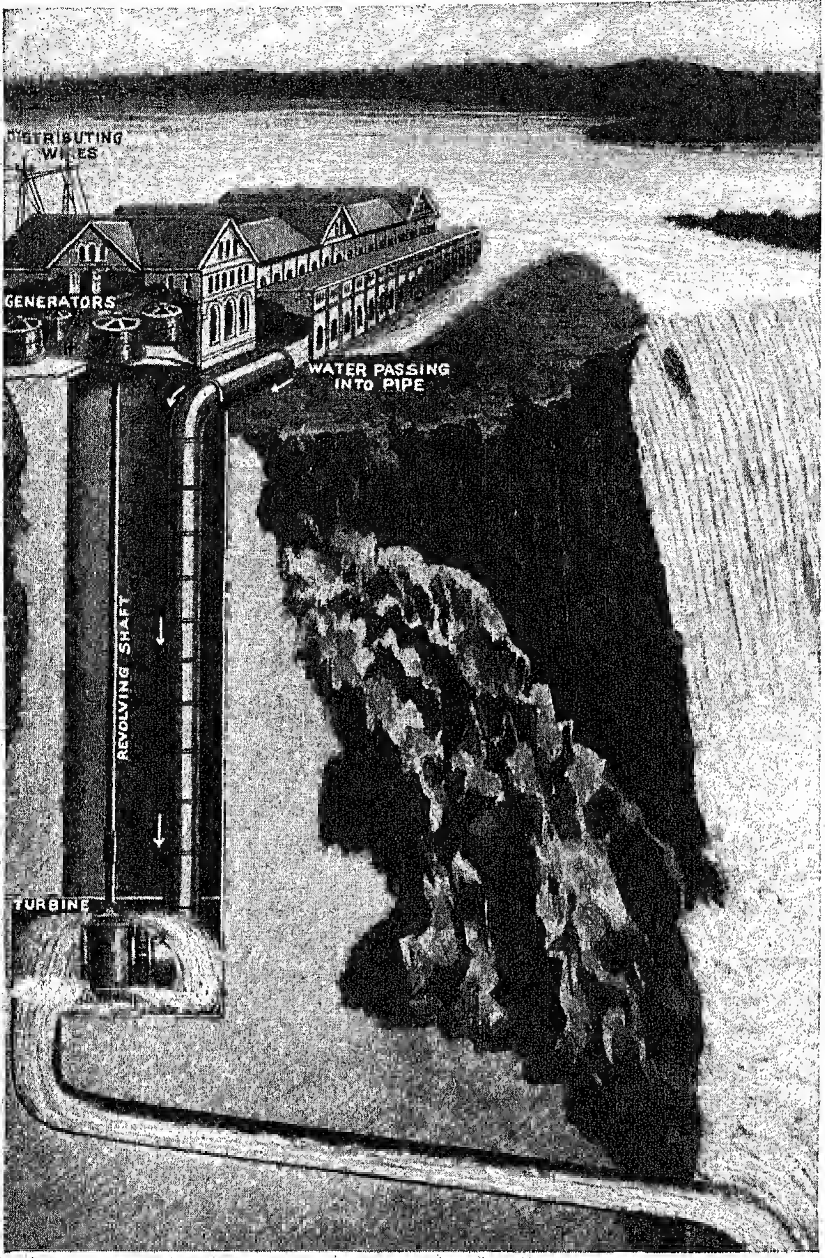
But the costs of building dams and plants are not the only ones. Many of the best water-power sites lie far away from industrial centers, and the transmission of electric current over those distances is expensive. In some instances the bill for transmission lines with their high steel towers amounts to $25,000 a mile. A 200-mile line, which is about the limit over which current can be carried without prohibitive loss of power, would therefore involve an investment of $5,000,000.

The uncertain flow of streams further complicates the problem. Many dwindle to almost nothing at certain seasons and at others turn into rushing torrents. To maintain the constant power supply required by industry, vast reservoirs have to be built to store the surplus of the flood season to be released according to power requirements during dry periods.

Much water power is used in conjunction with steam power. The Conowingo plant on the Susquehanna River, for example, with a capacity of nearly 600,000 horse-power, coöperates with steam plants to light Philadelphia.

The energy of falling water is usually put to work through some type of wheel. Until the comparatively recent invention of the turbine, all water wheels were merely variations of the paddle wheel. If the stream is carried by a flume and allowed to strike buckets or paddles on top, the wheel is called "overshot." If the stream passes beneath the wheel, it is "undershot." A third type is the "breast wheel" in which the water strikes the wheel at a level with the axis or slightly above. But such wheels cannot deliver power satisfactorily in the enormous quantities needed by modern plants. They have given way to the newer types of wheels and turbines, usually connected

HARNESSING THE POWER OF NIAGARA



Falling water, as nature provides it, is the cheapest and most dependable source of power. Ancient water wheels and mills show that men have known for ages that this power could be utilized. Here you can see exactly how modern engineers have harnessed Niagara Falls, so that the energy which would otherwise be wasted is used to create electrical power. The water is first diverted into a pipe or series of pipes, through which it falls with tremendous force to operate a turbine engine at the bottom. This turbine engine then turns a driving shaft, which sets the electrical generators to work. From the generators distributing wires carry electric current to cities and towns many miles distant.

to an electric generator. Turbines are nothing more than ingeniously devised wheels inclosed to take full advantage of high-pressure flows. (*See* Turbine.)

In one type—the Francis turbine—which is used where the fall is moderate (less than 850 feet) but the quantity of water is large, the flow is directed against a series of buckets fastened to the shaft. The Nagler propeller, built on the principle of a ship's screw or an electric fan, is often employed where the pressure is lower but the supply is steady. To take advantage of the kinetic energy of small volumes of water falling great distances, as in the numerous "bridal veil" falls of the Far West, ranging from 1,000 to 4,000 feet, the flow is concentrated into swift jets against twin buckets fastened around the rim of a Pelton wheel.

The mammoth pipes which bring the water to the turbines in the power house are known as "penstocks," and are sometimes large enough for a freight locomotive to run through. Where the water pressure is great, the penstock must be constructed to withstand pressures of sometimes more than 1,000 pounds per square inch. Valves control the flow of water through these penstocks. A single valve at the Niagara Falls plant has movable parts weighing 54 tons, and weighs some 307 tons.

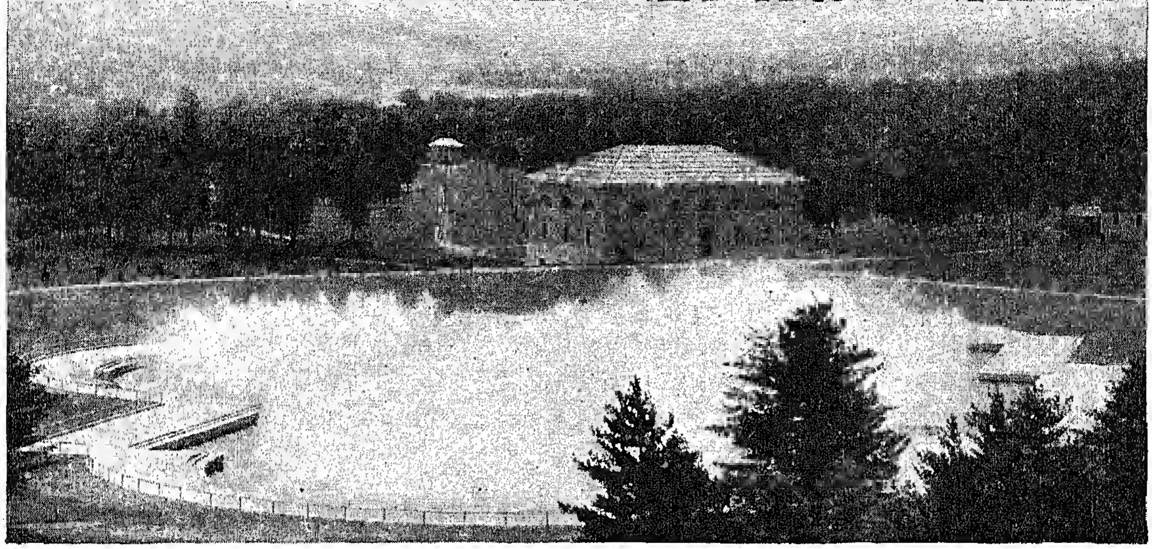
Water and water power have many mechanical applications other than those mentioned here. A wide variety of hydraulic presses and rams are used in industry. The old-style safe and slow hydraulic elevators may still be seen in many places. The hydraulic ram pump that uses water power to make water flow up hill is one of the most ingenious of these devices (*see* Hydraulic Machinery).

Machines to harness the ebb and flow of tides, the force of ocean waves, and the ocean currents are all among the power possibilities with which engineers are constantly experimenting. (*See also* Fuel; Power; Water.)

WATERSPOUT. Travelers and seamen sometimes tell strange tales of twisting columns of water called waterspouts which seem to rise from the surface of the

sea and reach up into the clouds. For a time it was believed that such spectacles were the result of a kind of suction that forced the sea water upward, but now we know that waterspouts are caused by tornadoes which form over lakes, streams, or the ocean itself (*see* Storms). The spout is merely the funnel-shaped cloud of all tornadoes. The water in the spout is fresh and not salt, a fact which proves that the column is formed by the condensation of the water vapor in the air. It is true that the water of the lake or ocean just beneath the spout is much disturbed and rises somewhat inside the column. That is due to the fact that the inside is almost a vacuum. The rising of the water is due to the same causes which blow out the walls of houses in a tornado. Waterspouts are most common in warm waters where thunderstorms are apt to occur. They are most numerous in the tropics of the Pacific ocean. They usually last for only a few minutes.

HOW *Modern* CITIES GET *Their* WATER



Aeration Fountain of the Catskill Aqueduct System of New York City

WATERWORKS. If by some magic we could see in a glass of water the moving picture of its journey to our home, we should see portrayed a story of much interest. In New York the story would start high up in the Catskill Mountains, where the pure waters of the mountain springs are gathered in great reservoirs one more than 90 and another more than 125 miles distant from the city. Great tunnels so large that a railroad train might enter are built from these to the city's water system. The water from the reservoirs is constantly slipping into these tunnels, to plunge downward through the darkness and mystery of the subterranean river, gathering a force from gravitation that will carry it through the water mains of the city up to the 20th story of the towering buildings. Imagine a good-sized river turned about so that its mouth is placed at the lake in the mountain. All the branches which were once feeders for the big river are now fed by the water rushing down from the lake, and the little branches are going out among the homes and great industries of the city.

In Chicago a number of tunnels, large enough for a man to walk upright in, run two and sometimes four miles out under the bottom of Lake Michigan, to bring in water which is purer than that nearer shore. First, the water flows into basins at the pumping stations, and then the great steel pumps, working ceaselessly day and night with the power of 10,000 horses, force it out through the distributing mains to all the parts of the city.

If you live on a farm or in a village, the story of your water supply has to do chiefly with the work of nature. We might begin each of these stories with the evaporation of the water from all the earth, when the vapor rises into the clouds to be returned to the earth as rainfall. Perhaps the rain is caught from the roofs of buildings where smoke and dirt are not excessive, and stored in cisterns for use in bath and laundry. In some instances this water is filtered and used for drinking. Or the rain falling upon the earth may continue its journey down through the ground which is nature's filter, to be stored in layers of porous rock or confined in rocky chambers. Wells are dug into which this water may seep. In such cases it is important to dig the wells where the soil is free from contamination with the agents of disease. Wells may also be bored or driven to tap the water which is deeper underground. The water from these wells may be drawn by the "old oaken bucket," the hand pump, or the pump operated by a windmill or gasoline engine. A constant and ever ready supply of water where and when needed may be obtained in the country as

well as in the city, for water may be pumped and stored in an elevated tank. From this tank, pipes can be installed leading to taps in the kitchen sink, the laundry, the milk house, the barn, or wherever else it is needed, and the stored water can then be used whenever it is wanted.

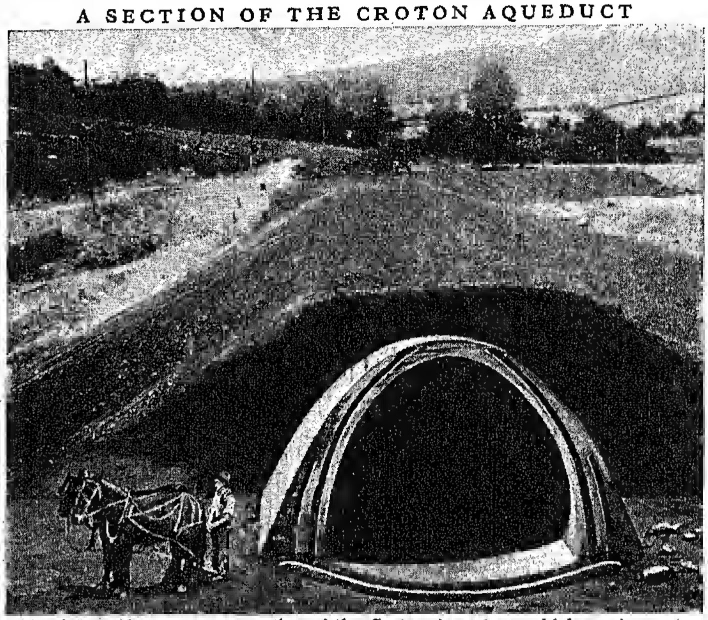
The American Indians and other tribal peoples made their camps beside the natural water supplies, and if for some reason these waters dried up and failed them, they would roll up their tents and move. Civilized man refused to move so easily. The Chinese have an ancient proverb which says, "Dig a well before you are thirsty." China has a great many wells. Some of them are 1,000 and 1,500 feet deep, and are probably the deepest wells that are used successfully.

But even numerous small wells could not supply the needs of the homes and industries of a great city, even those which existed in very ancient times. In Egypt, Assyria, and Babylonia, water was conducted from the river-beds through open canals to the cities, to help supply city dwellers. But the mighty Romans far outstripped all other peoples of ancient days in the energy and engineering skill devoted to the construction of their water systems. Rome brought water clear and fresh from the distant hills, and first nine and later fourteen streams flowed through costly and marvelous aqueducts of brick and stone to supply the city's fountains, public baths, and public buildings. The aqueducts of Rome were large enough to supply 375 gallons a day for each person, although the amount actually delivered may have been less because of leakage from the long conduits and storage reservoirs. Similar aqueducts were built for other Roman cities (*see* Aqueducts).

Water contaminated with sewage causes such diseases as typhoid, paratyphoid, dysentery, and one form of cholera, and the terrible ravages of pestilence which beset the cities of the Middle Ages undoubtedly were due to restricted water supplies or polluted water. Paris in 1550 had a drinkable water supply equal to one quart a day a person, and at the end of the 17th century the supply if evenly distributed would have amounted to only 5 pints a person. Our modern cities do much better than that. In the year 1854 the records show that Chicago pumped over 9 gallons a person, and now, 286 gallons a person, showing what progress has been made in that length of time. This last figure is larger than that shown for any other city in the United States, and European cities allow much smaller supplies.

We have learned to do one important thing which the Romans did not do, and that is to pipe this water into each house. The Romans served very few individuals and then only at a great expense, for a special lead pipe was run from the reservoir out to each house served. If the pipes distributing water in New York City today were laid in one continuous main they would reach from that city across the continent to Spokane.

A SECTION OF THE CROTON AQUEDUCT



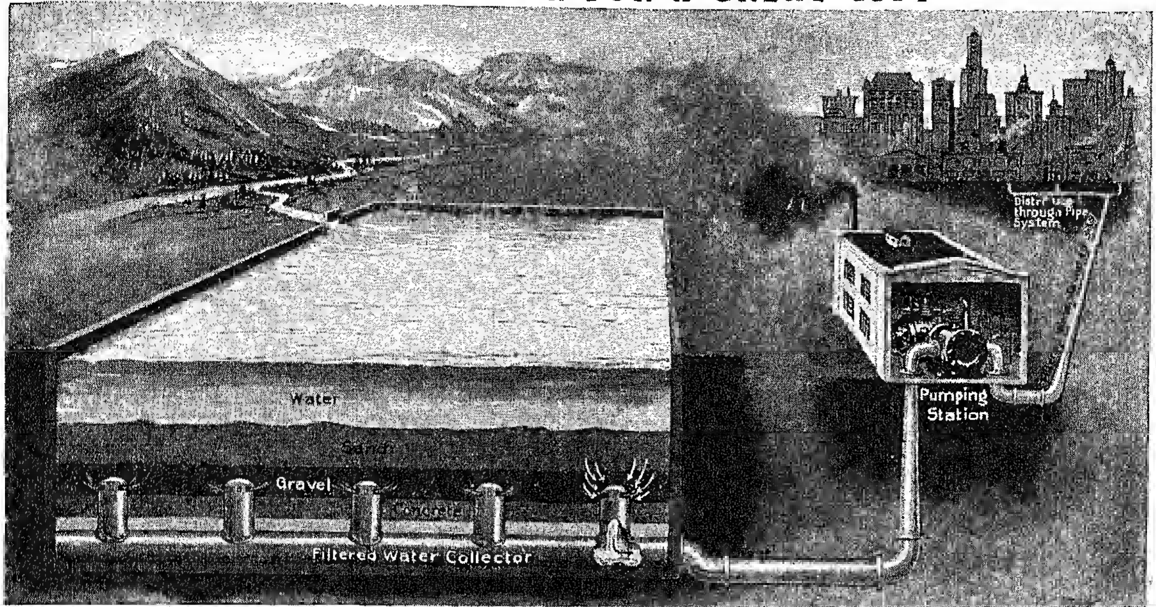
This picture shows a cross-section of the Croton Aqueduct, which carries water to New York City, as it looked when it was being built. You can appreciate the enormous size of this water tunnel by comparing it with the driver and his horses.

For the early distribution systems, hollow or bored tree trunks were used. The end of one tree pipe was tapered to fit into the hollowed-out end of the next tree pipe to make the joint. At one time the company which supplied water for London had 400 miles of wooden-pipe water mains. A great deal of water was wasted by leakage in such mains and the wooden pipes had to be renewed frequently. The pipes were small and as many as 10 separate lines were laid in some streets to furnish enough water to the customers on that street.

In the early systems, too, water was only pumped during a part of the day. If the baby of the household awoke in the middle of the night and cried for a drink of water, there would be trouble unless water had been put by for just such an emergency. Water was not distributed under pressure, either, so the water could be obtained only from faucets at or near the level of the ground. This was not only inconvenient but it afforded little fire protection. There was the further danger that impure surface water would seep into the leaky mains where the water flowed along without pressure and while the mains were not in continuous use.

The use of iron pipes became general at the beginning of the 19th century. With these pipes for the distribution systems, and the use of the steam engine to run the pumps, the development of the modern water

FILTERING WATER FOR A GREAT CITY



You think of a water filter as a small affair that might be installed in any kitchen. Consider, then, this filter which covers acres. The water flowing down from the hills is gathered in the reservoir, whose bottom is composed of fine clean sand overlying a gravel bed. The water seeps through, depositing its impurities in the sand, and is then collected through screened pipe-heads thrust up into the gravel. From there it is pumped clean and clear into the city mains. A filtering station usually has several of these reservoirs, so that the water from any one of them can be drained and the sand changed without interfering with the regular supply.

systems began. In the modern distribution system, water is supplied under pressure. This increases the amount of leakage from the pipe joints, but prevents the seepage of the surface water into the pipes. This pressure is maintained so that an exceptional demand, such as occurs in case of fire, finds the system instantly ready for the emergency. Such a practice of course makes it necessary to build the entire system on a scale suited for fire-protection, although for the greater portion of the year this great capacity is not needed. Some large cities are now avoiding a portion of this expense by building high pressure fire protection systems in the business and manufacturing districts, and providing domestic water supply from less expensive low-pressure systems. Modern cities are also abandoning the old "unlimited supply" system in favor of metered service, in order to distribute the expense among the water users in proportion to the amounts they use (*see* Meters).

The Science of Water Supply

Because of the enormous consumption of water in modern cities, and the necessity of finding this supply within a limited area, municipal water supply has grown to be a highly technical science. The basis of any water supply problem is the need—how much water must be delivered daily—and the probable future demand as the city grows. If a city does much manufacturing, engineers usually figure upon a total great enough to supply 100 gallons daily for every member of the current population, but are careful that the total capacity of the plant designed upon this basis can be increased as the population grows.

The next problem is to find this amount of water without drawing upon supplies needed for other cities. The first consideration is purity, and when possible engineers try to have a "drainage area" established in a mountain or forest region, and draw their water from it, sometimes with and sometimes without the use of purification processes. Such an area is then patrolled constantly by guards in order to prevent contamination. New York City's area in the Catskills is the leading example of this practice.

Usually, however, a sufficient supply can only be obtained by drawing upon water which in its natural state is admittedly impure, and in such cases some means of purification must be adopted. The "slow sand filter" depends on the formation, on the surface of a sand bed, of a slimy mass of organisms which acts as a bacterial filter. The "rapid sand filter" is chemical and physical rather than biologic in principle. The water is first dosed with some chemical to precipitate suspended matter and bacteria, part of which settles out in suitable basins, and the remainder is removed by passing through layers of sand and gravel. Rapid sand filters purify about 125 million gallons of water per day per acre of filter surface, which is from 30 to 50 times faster than the speed of slow sand filters.

The sedimentation process uses shallow basins or reservoirs without filter bottoms. The water is allowed to stand for a number of days in a basin before being used (intermittent system) or is made to flow gently from one to the next (continuous system). In either case, the impurities gradually sink to the bottom.

Chemical treatment consists either of coagulation or direct bactericidal purification. In the former process chemicals which produce a gelatinous mass are introduced into the water, and as this mass sinks, it strains out the impurities. Such a system is valuable when water is highly charged with mud. When the water is clear and only bacteria are feared, some bactericidal agent, as chlorine gas, is introduced, and the water is used without further delay. In a few cases where the only available water is particularly bad—as in the case of a large prairie city whose only possible water supply is from a dirty river—several of these processes may be used in combination.

After quantity and purity are assured, steadiness of supply must be provided for. Both drainage areas and rivers furnish most water in the spring, and least in the summer, when water is needed in the greatest quantities. In order to preserve the spring-time excess for use in the dry season, great dams impound the water in artificial lakes designed to hold enough water to supply the city during the times when the natural daily supply is deficient.

We have learned from experience that water service because of its importance must be a *public* service available to everyone. Where private companies furnish water today, these companies are generally regulated by state or municipal commissions. Often the municipality has undertaken to furnish the service as a department of the local government, and in a number of states these municipal utilities are regulated by the state commission the same as private companies. (*See* Public Utilities.)

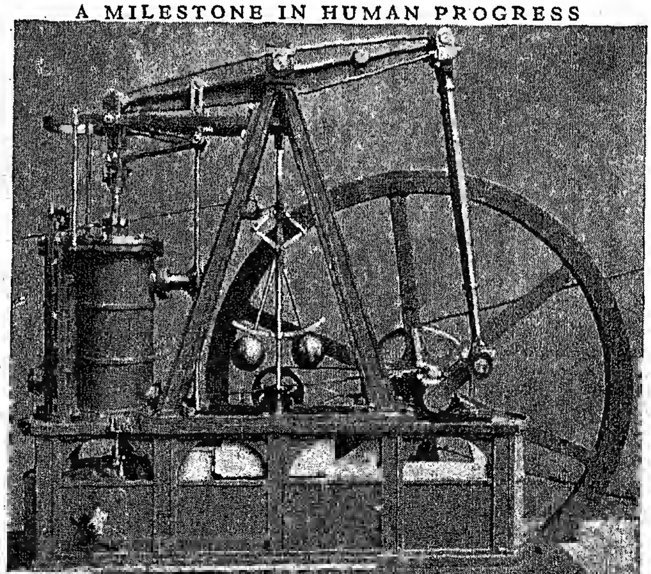
If you live in a city perhaps you can find out what kind of a water system you have. A visit to the pumping station will show you the great pumps which throb ceaselessly day and night, sending the water through the main arteries, out through the smaller branches, to the very fingertips of the city.

WATT, JAMES (1736–1819). Everbody has heard the story of James Watt and his boyhood experiment on the lifting power of the steam under the lid of his mother's tea-kettle. It is a beautiful picture, that of the home life of James Watt, in the fishing-town and customs-port of Greenock, Scotland. He was a delicate sensitive lad, whose life was preserved only by the most tender care. His father was a man of means and importance, and his mother was known to the fisherfolk as "the beautiful leddy."

WATT
Who Perfected the Steam Engine

Unable to attend school regularly because of ill health, James Watt followed his own inclinations in study and amusements. Long days were spent in rambling among the hills and lakes back of the town, developing strength and turning his thoughts toward botany, geology, and water-power. He was no less interested in his father's shipbuilding yards and in the docks. He loved to sit in the window of the parlor fronting the harbor and watch the herring boats come in and the big sailing vessels, laden with tobacco from Virginia, riding at anchor in the broad estuary of the Clyde. Who could imagine that this fragile dreaming boy was to transform his native town from a straggling village of thatched cottages into a big bustling seaport with great shipbuilding yards where the Cunard and other famous lines of steamers are constructed and sent out to sea?

A MILESTONE IN HUMAN PROGRESS

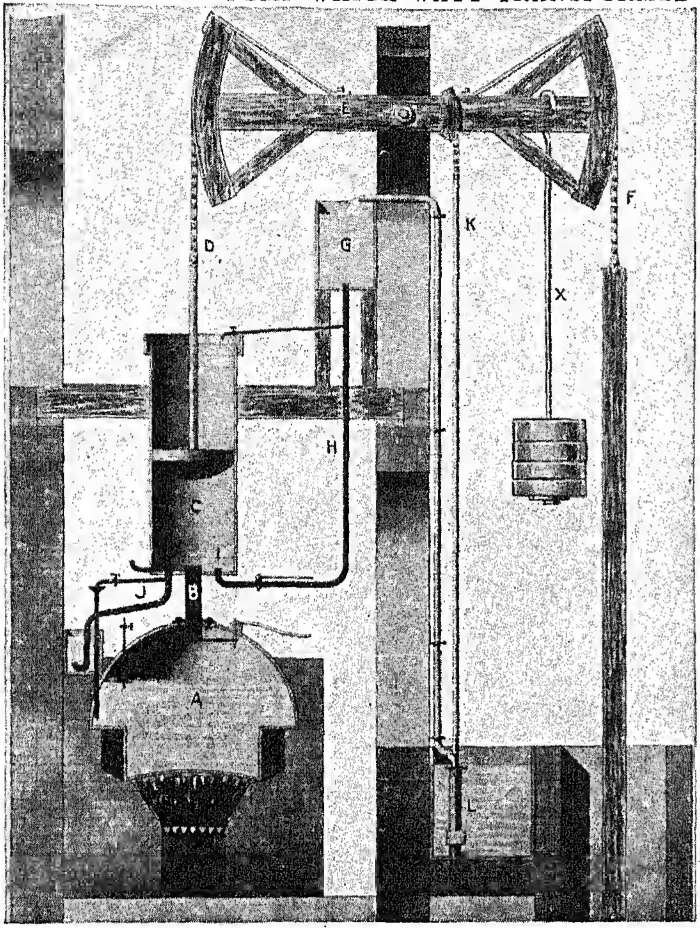


This is the original model of James Watt's perfected steam engine, as it appeared about 1800, the year in which Watt retired from active work. Before Watt's time, the steam engine was useful only as a pump, but Watt adapted it to drive machinery of all kinds.

In his father's shops the boy became so skilful in the use of tools that the workmen said of him: "Wee Jamie hae a fortune in his fingers, an' anither in his heid." It was intended that the gifted boy should go to Glasgow University and be fitted for a professorship in physics, but the loss of a vessel at sea and other family financial misfortunes forced him to abandon this ambition. So the lad went to London at 19, to learn the trade of scientific instrument-making. It took 12 days' hard riding to make the journey of 400 miles.

When he had learned his trade he was appointed mathematical instrument-maker to the Glasgow University, with a shop in the college precincts. One day a small model of a steam-pump from the University laboratories was put into his hands for repair. This led him to make a thorough investigation of the whole subject of steam, including condensation and latent heat, to see why this sort of pump, then used in British coal mines, used so much steam and gave so little power. He set about the task of improving and developing this crude and wasteful type of engine. It took a year of close study. But let the inventor tell the story.

THE AWKWARD PUMP WHICH WATT TRANSFORMED



This is Thomas Newcomen's engine, as it was before Watt began his experiments to improve it. The steam from the boiler (A) passed through the pipe (B) into the bottom of an air-tight cylinder (C). The piston or plunger which fitted snugly in the cylinder was fastened by a piston rod (D) to a rocking beam (E), to the opposite end of which hung a counterweight (X). Tho steam was under very little pressure, but it was enough to relieve the vacuum beneath the piston in the cylinder, and as soon as steam rose the counterweight drew the piston to the top. Immediately this happened, water from the tank (G) ran down the pipe (H) into the bottom of the cylinder at (I). This cold water caused the steam to condense, again creating a vacuum below the piston, which was forced down once more by the air pressure above it. This process drew the pump rod (F) up and down, which worked a pump deep down in the mine. The rod (K) operated the small pump (L) which supplied the tank (G). The various valves were usually operated by hand.

"One Sunday morning," he wrote, "when I had gone for a walk in the Green of Glasgow, the idea occurred to me that, as steam is an elastic vapor, it would expand and rush into a vacuum. The separate condenser would take care of the exhaust, and the steam-jacket keep the cylinder hot. I rushed back to the university and broke in upon Dr. Robison, lecturer on chemistry, and cried: 'You needna fash yoursel' aboot that ony more, mon; you shall have steam boiling hot, in a boiling hot cylinder, and not waste a single particle.'"

The modern steam-engine had been born in James Watt's brain—a flash of genius, it has been called. Such it was, but it was the result of profound knowledge, intense application, and patience.

Watt's first changes made the steam-engine quick-acting, powerful, and saving of fuel, but it was still useful for pumping only. It was 16 years (1781) before it was developed to the point where it could turn a wheel and be used in spinning factories and in running other sorts of machinery. Watt's business partner, and the man who by his financial aid made the success of his inventions possible, was Matthew Boulton of Birmingham, a talented and far-sighted capitalist.

At 64 James Watt, having, as he said, "a sufficient fortune," retired to the country. He there spent nearly 20 years as an experimenter and physicist—in his many interests and activities resembling Benjamin Franklin. "What is life without a hobby to ride?" he is quoted as saying. He always had some scientific hobby to engage his inquiring mind. Now it was the composition of water, or an illuminating gas, or the fertilizing of his broad farm lands; at another time, a uniform system of weights and measures, anticipating the metric system of today; and one of the chief units of electrical power, the "watt" is named in his honor. With the eagerness of a boy he experimented in his laboratory, "wearing out my life, not rusting," until he died on Aug. 19, 1819. (*See* Steam Engine.)

WAVES. When you throw a pebble into the pond, the particles of water displaced by the stone rise in a ring—they must; there is no other place for them to go. Then gravitation pulls them down, displacing some of the water outside of the ring, which is thus in turn compelled to rise, only to be pulled down by gravitation; and so the circle of waves or ripples goes on widening.

The production of water waves by wind is similar. Wherever the wind makes an exceptionally heavy downward thrust at the surface, it displaces the water, which is piled up in a wave. As the wind keeps pushing

on the water, the depression or "trough" sinks lower and the crest of the wave rises higher. Behind the trough, a second wave crest rises followed by a second trough, and so on. The distance from trough to trough or crest to crest is called the wave length. Ocean waves over 70 feet high from trough to crest and over 700 feet in length have been observed.

After the mass of water forming a wave reaches its maximum height, it sinks down again, and the water in the wave troughs is forced up in turn. Thus the wave form moves forward across the surface, though the motion of the water itself is chiefly up and down. This may be compared to the waves made in a rope by shaking one end of it. They run the length of the rope, but the rope itself does not move forward. Only when a water wave cannot ball back freely, as when it reaches a shoal or a shore line, does the mass of water in it break over and roll forward.

Wave motion—in the general sense of a force that progresses across space without carrying with it a material substance—is widespread in nature. Thus sounds travel through the air by wave motion, though no particle of matter goes along with them (*see* Sound). Similar in principle, though more difficult to explain, are the wave motions, through apparently empty space, of light, heat, radio signals, and other forms of radiant energy (*see* Radiation).

WAX. The waxes are complex chemical substances related to fats, but usually harder and more brittle (*see* Fats and Oils). Moisture, heat, and the oxygen of the air affect them very little. Hence they are used widely to protect wood, metal, and other surfaces from decay, rust, discoloration, and wear.

The most useful waxes are those derived from petroleum, of which paraffin is the leader. From it are made protective polishes, electrical insulation, waterproof cloth and paper, cosmetics, and candles. A natural paraffin, ozokerite or mineral wax, occurs in Utah (*see* Asphalt).

Of the vegetable waxes, the most important is carnauba wax from a Brazilian palm, which gives the most durable polishes to wood, leather, and painted surfaces. Similar to carnauba is ouricury or licuri wax from another Brazilian palm. Other useful vegetable waxes include candelilla wax from a plant of Texas and Mexico; Japan wax from a sumac; myrtleberry or bayberry wax for candles; and sugar cane wax. Of the animal waxes, beeswax is the best known (*see* Bee). Spermaceti, used for ointments, and sperm oil, a liquid wax for lubricants, are obtained from the sperm whale. Chinese wax, deposited by scale insects on the ash tree, is refined for candles.

The sealing wax used on letters and documents is not really a wax, but a mixture of shellac or rosin with turpentine, coloring matter, and sometimes a chalk filler. (*See also* Gums and Resins.)

A PAIR OF ROVING FRUIT EATERS

These are cedar birds, the smaller members of the waxwing family.

WAXWING. The handsome waxwings with their brown crests and black masks have a mixed reputation, like gentleman-robbers of fiction. One day they descend on a fruiting orchard, strip it clean, and vanish again. The farmer then clamors for the right to shoot them on sight. In reply, bird lovers point to the charm of the accused—their gentle whispering voices, their exquisite beauty—and show that their robberies in any one locality are rare. So the waxwings continue to enjoy the protection of the law.

Their plumage is a delicate fawn shade, blending into rich brown and ashy gray. The short, square tail is tipped with lemon yellow. The wings are long and pointed, the secondary feathers tipped with flecks of scarlet which resemble sealing wax.

They are social birds and always travel in small flocks. When resting, they perch in close-set rows, talking to one another in soft hissing voices, preening one another's plumage. Their nests are bulky structures of grass, leaves, and sometimes mud. The females lay from three to five eggs of pale bluish-gray with dark markings.

The waxwing family has two American species closely resembling each other. The Bohemian waxwing (*Bombycilla garrula*) is the larger and may also be distinguished by the white markings on the wing feathers. It breeds in the northern parts of both the Eastern and Western Hemispheres, wintering southward in the mountainous states and in the upper Mississippi Valley. The cedar waxwing (*Bombycilla cedrorum*) or cedar bird breeds across central Canada and winters in the United States and south to Cuba and Mexico. There is also a Japanese waxwing in eastern Asia (*Bombycilla japonica*).

WAYNE, ANTHONY (1745–1796). "Mad Anthony" Wayne was one of the most striking figures of the American Revolution. He was one of the best generals on the American side and displayed the most reckless bravery and bold enterprise shown by any soldier on either side.

Like Washington he was a surveyor in early life, and was sent by Benjamin Franklin to Nova Scotia as agent for a proposed colony there. When the Revolutionary War began, Wayne raised a regiment of

volunteers, with which he served in the disastrous campaign against Quebec. For a time he commanded Fort Ticonderoga, and was raised to the rank of brigadier-general for his services there.

At the battle of Germantown his troops drove back the Hessians, and held their position until ordered to retreat. At Stony Point he inspired his troops to carry the strongest British post on the Hudson with a surprise night attack. This feat won the thanks of Congress, a gold medal, and his nickname, "Mad Anthony." He was sent south in 1781, and was at Yorktown with Lafayette when the war ended.

In 1792 Wayne was commissioned major-general and sent against the Indians. His victory in the battle of Fallen Timbers, Aug. 20, 1794, led to the treaty of Greenville, signed Aug. 3, 1795. By this treaty the Indians ceded the land which now makes up most of Ohio and southeastern Indiana. This service, which was fully as valuable as his exploits in the Revolution, was his last. He died at Presque Isle in Lake Erie Dec. 15, 1796.

WEASEL. Weasels are small mammals related to martens, minks, and skunks. Their bodies are slender, with long necks and tiny legs, and so they can twist and bend like snakes and enter holes where only a snake could follow.

The common weasel is found both in the Old World and the New. In North America it ranges east from the Rocky Mountains and south to Tennessee and North Carolina. It grows about eight or ten inches long. Its fur is light reddish brown on the back and whitish below. In northern districts all its fur turns nearly pure white in winter. This lets the weasel creep up unseen to its prey over the snow.

Weasels feed on mice, moles, and rats, following them into their holes. They attack even rabbits, grouse, and chickens, and they climb trees to kill nesting birds and devour the eggs. They are bloodthirsty creatures, killing more than they eat.

The ermine fur of commerce is usually the winter coat of a North American or Siberian member of the weasel family larger than the common weasel. The least weasel of Canada and Alaska, sometimes called the "mouse weasel," is one of the smallest carnivorous animals in the world. (*See* Ermine; Ferret; Marten; Mink; Skunk.)

Scientific name of common weasel, *Mustela vulgaris;* of least weasel, *Mustela rixosus.*

The WEATHER PROPHET *and His* WISDOM

WEATHER BUREAU. Will tomorrow be fair or rainy, hot or cold? The Weather Bureau answers that question, and nine times out of ten it is right.

Weather forecasts are reliable because of the scientific skill and accurate information used in preparing them. Every morning and evening, reports of weather conditions are gathered by wire and radio from more than 200 stations in the United States, from Canadian and Alaskan stations, and from ships at sea. The reports go to Washington, Chicago, Denver, San Francisco, New Orleans, and Jacksonville (Fla.). Forecasters in these cities predict the weather for their districts, and the forecasts are announced over the air, printed in newspapers, and distributed by mail.

This work costs the government from 3 to 5 million dollars a year, but the forecasts save many times the amount spent. Railroads protect shipments of perishable and refrigerated freight according to the temperature forecasts; ships may stay in port to avoid storms, or alter their courses at sea to escape a coming hurricane; farmers plan their next day's work to meet weather conditions; and fruit-growers learn of coming frosts in time to protect their orchards.

"Weather Signs" of Unscientific Days

Before this service was organized, people tried to predict tomorrow's weather according to certain "signs" that they could observe in their neighborhood. They said, for example, "A gray sunset means storm" or "A halo around the moon means rain." These rules were derived from generations of popular experience and had some value. Gray sunsets and moon haloes are caused by moisture in the air; this moisture is likely to result in rain.

Other popular rules were set up to predict the weather far in advance. These are worthless. We hear, for instance, that if the groundhog sees his shadow on February 2, winter will last six more weeks; if he does not, winter is at an end. It is true that the breakup of winter brings warm, cloudy days; so a cloudy February 2 suggests that winter *might* be breaking up. But one day's weather is not a fair test. Another belief without foundation is that rain on St. Swithin's day (July 15) means rain for 40 days.

The scientific forecaster also uses "signs," but his signs are far different. The farmer who predicts rain because the moon has a halo takes account of moisture in the air. So does the scientific forecaster—but the latter *tests* the amount of water vapor with instruments. Also, since temperature is as important as moisture in causing rain, he tests all conditions which may change the temperature.

How Winds Control Weather

To understand the work of the weather man, we must recognize, first of all, one chief difference between *weather* and *climate*. The character of climate is fixed chiefly by heat from the sun, and it changes gradually with the seasons. But weather may change violently in a few hours, as bodies of air with different amounts of heat and moisture are carried here and there over the earth by the winds. Temperature, moisture, and winds are therefore the chief weather elements.

Winds are caused by differences in the pressure of the atmosphere. When air is heated, it becomes less dense or heavy; in other words, it exerts less pressure. Colder, denser air with greater pressure then pushes in from the sides and forces the warmer, lighter air

upward. This is the full meaning of the saying, "Warm air rises." The top does rise; but the bottom is pushed up by denser air which flows from high-pressure regions, called *highs*, into regions called *lows*, which have warmer, lighter air.

We can see that a low, wherever it appears, will act like an atmospheric fountain, in which warm air is forced up until it becomes cool and dense enough to fall away like spray into the surrounding air. What we call "winds" is the movement of air into these low-pressure fountains.

Cyclones and Anticyclones

In temperate climates, the "fountains" responsible for most of our weather arise along the dividing lines between the world's great permanent or seasonal zones of high and low pressure (*see* Winds). Whenever some local condition creates a strong low-pressure area, winds blow in from all sides. As the article on Winds explains, these winds blow spirally, instead of straight, toward the low. The incoming air rises as it enters the fountain and finally falls away at the top. The effect is that of an air whirlpool, often hundreds of miles across. Once formed, this whirl is carried east by the prevailing westerlies.

Such whirls are called *cyclonic storms* (from the Greek word *kyklos* for "circle"). An area of high pressure from which winds blow is an *anticyclone*. Anticyclones, like cyclones, travel eastward. The unending procession of cyclones and anticyclones, bringing heat or cold, moisture or dryness, gives us weather.

Isotherms, Isobars, and Weather Maps

Weather Bureau forecasters study these whirls by making maps marked with *isotherms* and *isobars*, based on the reports they receive of weather conditions, at 8 a.m. and 8 p.m. eastern standard time, throughout the country. The *isotherms* are lines connecting all places reporting the same temperature (the name comes from the Greek words *isos*, "equal," and *thermē*, "heat"). A line joining places having the same barometric pressure is an *isobar* (from the Greek *isos*, "equal," and *baros*, "weight"). The isobars show the highs and lows; arrows show wind directions.

Moisture and Precipitation

The remaining great factor in weather is *moisture*, or lack of it. Warm air sucks up moisture and holds it as water vapor (*see* Water). When the air cools, it cannot hold all the vapor, and the excess is squeezed out, or *precipitated*, as rain, snow, frost, or dew. A cyclone traveling across the country acts like a great pump, drawing in moisture-laden winds from the east, southeast, and south, and cooling the air as it rises until moisture is precipitated from the center of the storm. Westerly winds drive the cyclone along and do not enter its whirl to any considerable extent.

On the weather map, *amounts* of precipitation are shown in hundredths of inches of rain; snow is melted to water for this calculation. Symbols show the *kind* of precipitation, either snow or rain.

The accompanying picture shows these cyclonic forces at work, while the weather map shows how the same storm is diagrammed by the Weather Bureau. We can see why some popular weather "signs" have the same basis as the Weather Bureau's data.

One good sign of storm is cirrus or cirro-cumulus clouds, such as "mare's tails" and "mackerel sky" (*see* Clouds). These may appear 48 hours before the storm. Hence sailors say,

> Mackerel scales and mare's tails
> Warn great ships to carry small sails.

These clouds are unprecipitated moisture, usually frozen, which pushes up from the top of the cyclone and is carried east at great speed by the fast winds of the upper atmosphere.

By noting the clouds and their movements, we can often locate the storm center. As the storm draws nearer, its moisture and lower pressure make the air feel "muggy"; animals and people alike are restless and uncomfortable. Rain or snow may fall as the center of the storm approaches. Behind the center lies a zone called the "trough" of the storm. Here high-pressure air from the west may drive forward a visible *line* of cloud and storm. This is a "line squall," and lies across the wind.

After the trough passes, "west winds bring clear weather." Although the denser air of the anticyclone may place half a ton of extra pressure upon an average adult, we "feel good." The sky is clear, perhaps with a few fleecy clouds, and sunsets are brilliant, because the air contains little moisture to interfere with the refraction of the sun's rays (explained in the article on Twilight). But, surprisingly enough, a red *sunrise* is a sign of rain. Sunrises are brilliantly colored when a cloud blanket has kept the air from absorbing moisture during the night. Unless conditions change, the air cannot hold the moisture which daytime heat will evaporate, and we have rain. This gives us another "rule,"

> Sky red in the morning, a sailor's true warning.'
> Sky red at night, a sailor's delight.

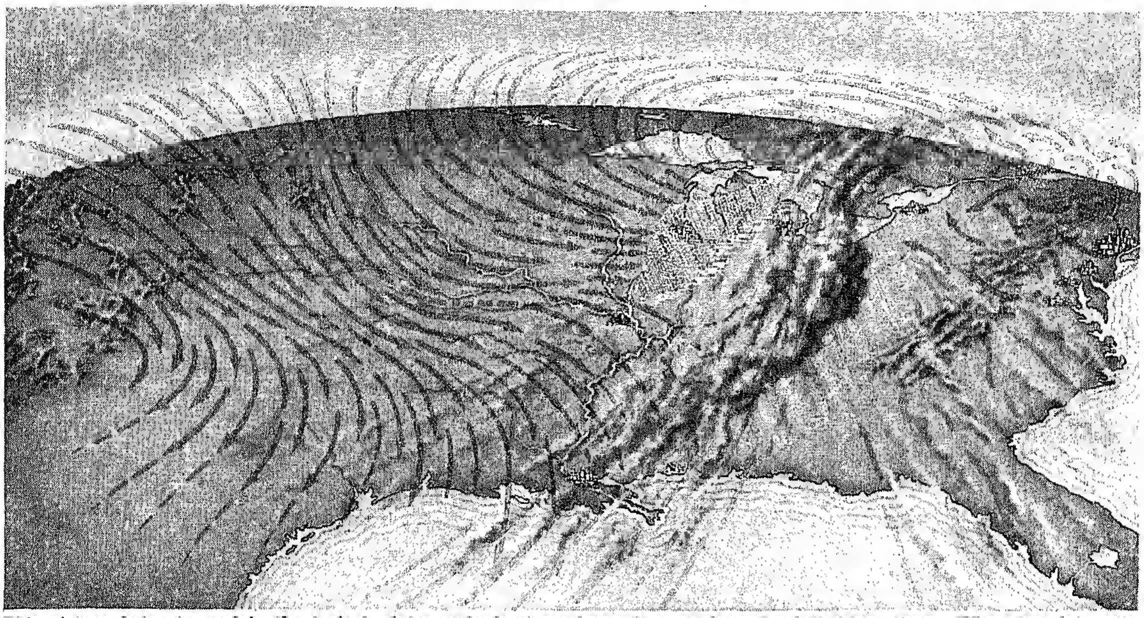
Regional Differences in Storms

Cyclonic storms bring rain wherever they can draw moisture into the whirl, from the east, southeast, or south. Thus, while most New Englanders believe that they get bad weather from the Grand Banks to the east of them, the rain actually is brought by a cyclone from the west which, as it approaches, draws clouds and moisture from the Grand Banks. Cyclones from the North Pacific have a different story. They drop their ocean moisture as they climb the Coast Range of mountains and the air they draw in on the other side comes from regions to the east, southeast, and south which are comparatively arid. Hence they remain "dry" until the cyclone center is about over the eastern part of Nebraska or the Dakotas. There moisture enough to renew precipitation is brought to the center by winds from the Great Lakes.

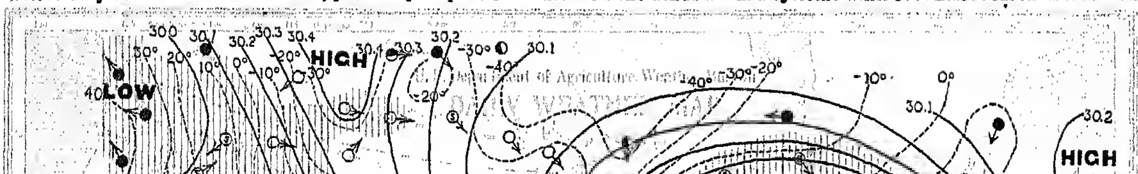
Cold Waves, Hot Waves, and Blizzards

When we know the causes of weather, and the great world sources of hot, cold, wet, and dry winds (explained in the articles on Climate and Winds), we can

A CYCLONE AND ITS WEATHER MAP

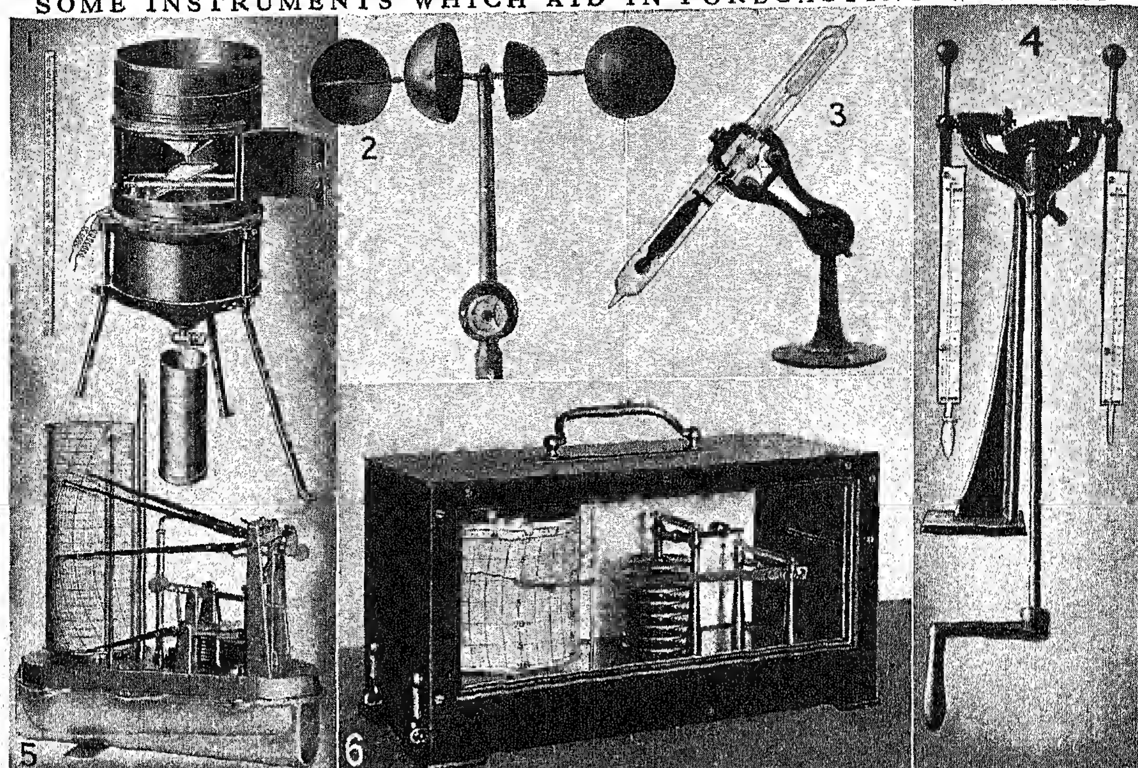


This picture helps to explain the typical winter cyclonic storm which is mapped below. Where the cold, high-pressure air (shown in blue) meets the warm, low-pressure air (shown in orange), the moisture in the warm air condenses, forming clouds. Where very cold air meets warm air, you see precipitation in the form of snow, shown by dotted blue lines. Where less intensely cold air meets warm humid air you see precipitation in the form of rain, shown by dotted orange lines. Notice how the tongue of warm air veers northeastward and rises above the cold air, and how the winds are in a cyclonic whirl over Lake Huron as a center.



This is an official weather map reduced in size. Names and notes are too small to read, but the most important features are clear. They show the same storm that is diagrammed in the upper picture. The solid black lines are isobars. They show the *concentration* of low pressures which accompanied the storm in the central region marked LOW, as well as the relative position of the HIGHS around the low-pressure area. The broken lines are isotherms. Notice the differences in temperatures they reveal between the areas where it snowed and those where it rained. The arrow attached to each small circle shows the direction in which the wind was blowing at that point. Clear circles mean *clear skies; half-black circles, partly cloudy;* black circles, *cloudy;* an R in the circle, rain; and an S in the circle, snow. The area shaded blue has had precipitation of 0.01 inch or more within 24 hours. The government maps use black shading; but blue shading is used here, to aid visibility on the reduced map.

SOME INSTRUMENTS WHICH AID IN FORECASTING WEATHER



The principal types of instruments which forecasters use are shown above. The rain gauge (1) catches rain in its open top, and drains it into the bucket seen inside the gauge. When the bucket receives 1/100th of an inch of rain it dips and pours the rain into the container below. The movement also operates an electrical instrument which records the rainfall. The ruler at the left is used with the lower container to measure the rain in hundredths of an inch. The Robinson-type anemometer (2) measures wind speed. The wind whirls the cups around, and the dial at the base, or an electrical recorder, registers the speed. The wind speed recorder is called an anemograph. The sunshine recorder (3) has a black bulb which absorbs heat whenever the sun shines. The heat causes mercury contained in the bulb to expand and close a gap between two electrical terminals at the middle of the tube. Current then flows to an electrical instrument which records the sunshine. The next picture (4) shows a whirling type of wet-and-dry-bulb hygrometer, or psychrometer, which measures humidity. It is operated by a hand crank. The combination recording instrument (5) is carried by airplanes to test conditions in the upper air. The recording barograph (6) makes a record of atmospheric pressures throughout a week. The revolving drum at the left carries a paper marked for days and hours. The disk drum in the center is an aneroid barometer. As it expands or contracts, it moves a pen-tipped arm over the drum to record pressures. A similar device may be used to record temperatures; but more usually, weather stations use multiple recorders, which register several factors.

understand hot and cold "waves." Cold waves come from the North Pacific or from Canada. If the advancing cold air strikes warmer, moister air, it may drive forward a "blizzard" of snow.

A hot wave occurs when the difference between highs and lows over the country is not great, so the hot lows tend to stagnate wherever they are. On the Atlantic coast, heat waves may also come from the mid-Atlantic or "Bermuda" high. The air of this high is oppressively humid. Whenever the general cyclonic circulation is weak, this air may flow gently over the coast until thundershowers or the approach of a cyclone from the west breaks the heat.

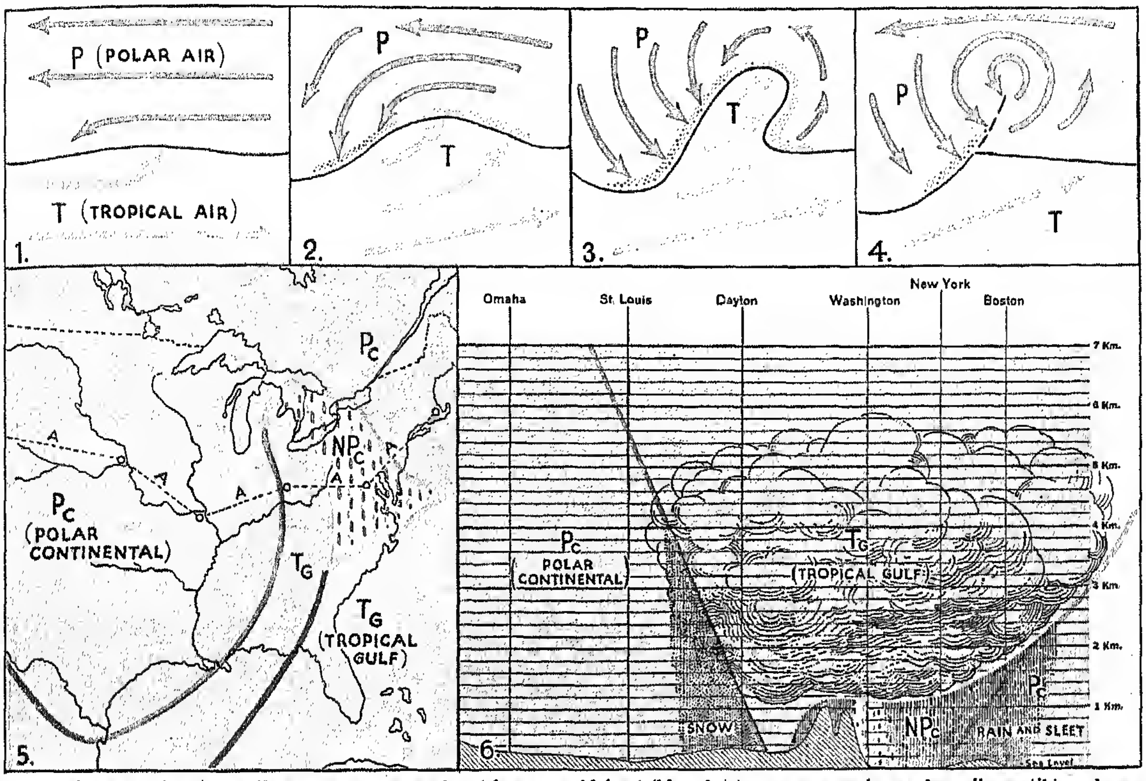
Is the Weather Man a Good Guesser?

The Weather Bureau considers a temperature forecast accurate only when it is within 7° F. of the actual temperature in summer, within 9° in spring and autumn, and within 11° in winter. Predictions concerning rain or snow are rated as correct only when proved to be so by the official gauges at the station. For example, a prediction of rain at a certain station is considered incorrect if the gauge is dry, even though rain may fall half a mile away. Accurate prediction is hardest in northern Michigan, where 84.7 per cent of the predictions are correct. This is because in the region along the Canadian border the greatest conflicts in North America take place between warm air from the south and the southwest, and cold air from the north and the northwest. The resulting turmoil makes prediction correspondingly difficult. Accuracy increases roughly with distance from northern Michigan, to 88.8 per cent in New Jersey, 91.3 per cent in Florida, and 94.4 per cent in the mild, even climate of southern California.

The weather forecaster's hardest task is forecasting local precipitation, such as thundershowers and snow flurries. To understand this work requires detailed knowledge of how mixed air and water behave, the effects of vapor pressure and relative humidity, and the influence of altitude upon air conditions.

Since much of our weather originates in high-pressure areas over the oceans, the forecasting services of

PREDICTING WEATHER BY AIR MASS ANALYSIS



These diagrams illustrate the modern theory of cyclonic storms, which is applied in predicting weather. The diagrams in the top row show the development of a cyclone viewed from above. Diagram 1 shows heavy, cold air (P) in blue, and light, warm air (T) in orange. The surface separating them is called a *front*. In Diagram 2 unusual heat or some similar local condition has caused the tropic air to flow northward and form a *warm front*, shown by orange dots; the polar air curves around and forms a *cold front* (blue dots). In Diagram 3 the polar air has almost encircled a tongue of tropic air, and the two air masses have formed a cyclonic whirl of the type pictured on page 60*a*. Diagram 4 shows the final stage of the cyclone when the tropic air has risen and been cut off entirely from the ground. Its boundaries then are called *occluded fronts*, and the axis of the occluded mass is indicated by a broken line. The cold air then forms a whirl of wind on the surface; this whirl grows weaker and smaller until in a day or so it disappears. Diagram 5 shows how the air masses of the storm mapped on page 60*a* lie over the ground, while Diagram 6 shows the vertical arrangement of the masses. The different masses and their symbols are explained in the text. The information needed for such a diagram is obtained by airplane flights, in this case made along the line marked A-A in Diagram 5. The vertical scale is laid off in kilometers, and is greatly exaggerated.

all great nations have arranged to receive daily reports of weather conditions from ships at sea. A special radio code simplifies transmission of the data. The United States Weather Bureau also distributes equipment to properly qualified volunteer observers who report conditions in their vicinities. Observations in the polar regions contribute valuable data to the science of weather (*see* Antarctic Continent).

The forecasting services would like to develop long-range forecasting, so that farmers can be told, for example, whether a coming season will be rainy, normal, or dry. South African meteorologists have made encouraging progress in predicting seasonal rainfall from the trends of pressure and temperature over the Indian Ocean and the South Atlantic during preceding months.

Prediction by "Air-Mass Analysis"

The forecasting methods so far explained use data obtained on the earth's surface and mapped on *synoptic charts* which give a "synopsis" of the surface weather. But conditions in the upper air also affect weather; and a system using upper-air observations, called "air-mass analysis," was developed during the World War by the Norwegian physicist Vilhelm Bjerknes and his son Jakob.

Older theories of weather accepted two regions as sources of weather in the middle latitudes. These regions are the high-pressure polar regions and the high-pressure belts along the Tropic of Cancer and of Capricorn (*see* Winds). Winds from each region naturally meet along a division called a *front*, and by interaction set up cyclonic whirls.

The Bjerknes theory, also called the *polar front* theory, added the assumption that the cold polar winds cut under warmer air and force it up off the earth. This warm air, though in the upper atmosphere, has considerable effect upon the weather; but forecasters could not predict these effects from data obtained on the earth's surface. The Bjerknes method uses data obtained by sending instruments into the upper air attached to airplanes or sounding balloons. When once the conditions in the upper air are known, forecasters can make better predictions, particularly of precipitation. This method was officially adopted

in the United States in 1933; but airplane companies had used it before, to predict flying conditions. Prediction was speeded also by using teletypewriters, which place weather data before all forecasters at the same time.

In American forecasting, seven types of air masses are considered. With the symbols used to mark them on maps, they are as follows: Polar Pacific (Pp); Polar Continental (Pc, from Canada); Tropical Gulf (Tg); Tropical Pacific (Tp); Tropical Marine (Tm, from the Atlantic); Tropical Continental (Tc, usually from the southwest); and Tropical Superior (Ts). The last is dry, high-pressure air which comes from over Bermuda or the Pacific Ocean west of California. It settles gradually upon the earth, and is heated by compression to cause a Chinook wind or a hot wave. The letter N prefixed to a symbol indicates that the mass has been neutralized by mixture with air of markedly different temperature and moisture content. A neutralized mass also is called a transitional mass.

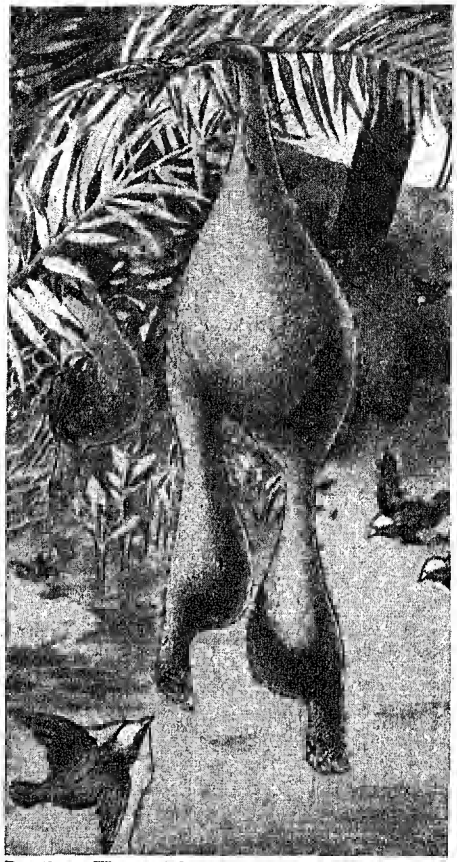
The Science of Meteorology

The name *meteorology* for the science of atmospheric conditions and weather is from the title "Meteorologica" of Aristotle's book on the subject. (The title was coined from the Greek words *meteoros*, meaning "high in the air," and *logos*, meaning "discourse.") Aristotle could only guess, for facts could not be learned until the thermometer and the barometer were invented some 2,000 years later.

About 1670, Robert Hooke devised the markings such as "Fair" and "Rain" which we still find on household barometers; other scientists, including Boyle, Halley, Lavoisier, and Dalton, applied discoveries about gases and heat in explaining weather, and achieved a fair understanding of winds and storms. LaMarck, Laplace, Lavoisier, and Brandes evolved synoptic maps as a basis for weather study. Important American additions to weather knowledge were Espy's book, 'Philosophy of Storms', published in 1841, and Maury's studies of storms at sea. Once the electric telegraph was invented, scientists could gather weather data quickly, and make forecasts.

In 1851 a map showing daily weather conditions in England was maintained at the London World's Fair. The Smithsonian Institution prepared such maps in 1854. After the Civil War, Congress authorized the Chief Signal Officer of the Army to forecast storms and floods. By his work for this service Cleveland Abbe, "the father of the Weather Bureau," proved the value of forecasting; and in 1890 Congress established a Weather Bureau in the Department of Agriculture (moved in 1940 to the Department of Commerce).

HANGING NESTS OF THE WEAVER-BIRD



The Baya Weaver-Birds of India usually build their nests from the branches of a tree which overhangs a stream. The nest is weighted with lumps of clay to prevent it from swaying with every breeze. The natives say that the birds catch fireflies and fasten them into the nest for the purpose of frightening away rodents, snakes, and other enemies. Enemies other than birds also are hindered greatly by the difficulty of getting into the nest through the entrance tubes at the bottom.

WEAVER-BIRD. Of all bird homes, those made by the weaver-birds are the most wonderful. Though they vary in size and shape, the same elaborate interweaving of grass or leaf-strips is found in all the nests of the 350-odd species of this family.

The weavers are small finch-like seed-eating birds, found principally in Africa, but also in Asia and in Australia. Their plumage is plain except during the mating season, when the males show bright colors. The birds chirp and chatter continually, but do not sing. A typical nest built by the baya of India, starts from a bough as a solidly-woven rope. Then it broadens into a globular chamber, and ends in one or more tubes, through which the birds enter. Usually the nest is built over water.

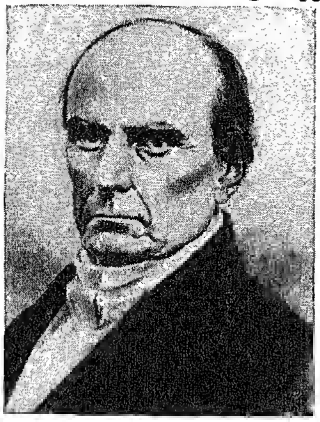
The social weavers of Africa build huge community nests in trees. The nest is woven of grass, and each pair of parent birds uses the same compartment year after year. The young birds add their nests to the structure, until the circular roof becomes so large that it may be mistaken for a thatched roof of a native hut when seen from a distance. As many as 320 individual nests have been counted under one of these community roofs.

WEBSTER, DANIEL (1782–1852). On Jan. 26 and 27, 1830, the United States Senate heard what probably was the greatest speech ever delivered before it. "Black Dan" Webster, senator from Massachusetts, made it in answer to Senator Hayne of South Carolina, who had said the Federal government was a mere confederation of states, and that the states could refuse to obey laws passed by Congress whenever they saw fit.

Webster showed that this doctrine of *nullification* could lead only to armed strife, and lifted the question of states' rights from the plane of political theory to a level of national patriotism. This speech closed with the memorable words, "Liberty and Union, now and forever, one and inseparable!" It placed Webster in the front rank of American orators, and won him enduring fame for statesmanship as well.

The man who made this great speech was born on Jan. 18, 1782, at Salisbury, N. H. How often, in reading the lives of great men, do we find them so frail in

childhood that it was not thought probable they would live to maturity! Daniel was so delicate that he was the only member of a pioneer family who was exempt from hard labor. His mother, a woman of uncommon intellect and force, early discovered the boy's remarkable mental powers, taught him all she knew, and insisted upon his entering the local academy. When he was 15 it was decided at a family conference that he must go to college, no matter at what cost of toil and self-denial for the others. The sensitive boy burst into tears at this proof of devotion and confidence in his ability. When he graduated from Dartmouth, he taught in an academy until he could send his brother Ezekiel also to college. After being admitted to the Boston bar, in 1805, he settled in the small town of Boscawen, N.H., in order to be near his father, who died a year later. Returning to Boston, he established a good practice, only to turn it over to his brother and to begin again in Portsmouth. American history records no finer example of family affection and loyalty than is furnished by the Websters. "Black Dan's" loyalty was wide as well as deep. In a Fourth of July oration, delivered at the age of 18, he made an impassioned appeal for love of country, in a time when the people as a whole had scarcely outgrown their strong sense of separate colonial origins.



WEBSTER
America's Most Brilliant Orator

His Eloquence Brings Him Fame

So shy as a child that he could not stand up in school to speak pieces, Webster won such a reputation for eloquence at the bar that, at the age of 30, he was a member of Congress from New Hampshire. After remaining there four years, he retired to return to the Boston bar. His income soon rose to $20,000, a great sum in those days. His reputation became national with his winning of the famous Dartmouth College charter case. This decision was of importance because it asserted the authority of the Federal government over the states, and was a blow at the theory of states' rights. In this early period he delivered a trio of historical orations—one in 1820 on the second centennial of the landing on Plymouth Rock, one on the laying of the corner stone of the Bunker Hill Monument, and one on the deaths of ex-Presidents Adams and Jefferson in 1826. These addresses served still further to place his broad patriotism before the American public. Such a man could not escape the duty of public service. In 1823 he was again in Congress, this time from Massachusetts. In 1828 he was chosen to represent Massachusetts in the Senate. There he remained until his death in 1852, except while serving as secretary of state under Harrison and Tyler, and again under President Fillmore. While in this office he negotiated the treaty with Great Britain which settled the Maine boundary dispute.

On many political questions of the day Webster seemed then to vacillate. In perspective he is seen to have been consistent to one principle. A free-trader, he became a protectionist on the ground that, since protection had been established, it must be maintained or businesses built up under it would be demoralized. Although opposed to the extension of slavery, he joined Clay in securing the passage of the Missouri Compromise. On the other hand he supported Jackson in the Force Bill, which authorized the President to use the army and navy to enforce Federal laws in any resisting state. The truth is that he hated nullifier and abolitionist alike, and fought every measure and every opinion which tended to divide North and South. He was concerned only with preserving the Union. As early as the great speech of 1830 he predicted civil war as the inevitable result of these sectional interests, but he helped to delay the conflict until the Federal government was strong enough to meet the shock. In the meantime he sowed seeds of national patriotism broadcast by his impassioned eloquence and unanswerable logic of history. His compromising attitude on slavery probably lost him the presidency, for abolitionist sentiment was growing in the North, and the abolitionists could not forgive his support of the Compromise of 1850. But the principles laid down in his speeches were followed consistently by President Abraham Lincoln.

WEBSTER, NOAH (1758–1843). Few men have had as great an influence in fixing the pronunciation and spelling of our language as this man whose name became synonymous with the word dictionary.

Noah Webster was born in Hartford, Conn., and educated at Yale College. His studies were interrupted by the Revolutionary War, in which he served as a volunteer, but he was graduated in 1778. While teaching in Goshen, N.Y., in 1782–83, he became aware of the need of better textbooks, and shortly afterward published his famous 'Spelling Book', which was widely used for nearly a century. In the next 20 years he practiced law in Hartford, edited a paper in New York, served as judge and member of the Connecticut House of Representatives, and wrote political pamphlets and a number of books.

In 1807 he began his 'American Dictionary of the English Language'. To fit himself for the work he spent ten years in the study of the English language and its connection with other languages. Seven more years were spent in preparation of the dictionary, including a visit to Europe to consult books and scholars at Paris and Cambridge. The fact that Webster included 12,000 words and between 30,000 and 40,000 definitions that had not appeared in any earlier dictionary indicates how thoroughly he did his task.

The work was finished in 1825 and published in 1828 in two volumes. Since that time it has been a standard dictionary of the English language.

In compiling his dictionary Webster had in mind the special needs of his own countrymen. He followed the best American usage of his time, sometimes departing slightly from the English forms, and choosing the simpler of two spellings whenever he felt warranted in doing so. He is responsible for fixing the spelling *wagon*, instead of *waggon; develop*, rather than *develope; theater, miter, center*, rather than *theatre, mitre, centre; color, labor, honor*, instead of *colour, labour, honour;* etc.

While working on the dictionary, Webster lived part of the time in Amherst, Mass., and was one of the founders of Amherst College. He also served in the Massachusetts legislature. He returned to New Haven in 1822, and died there in 1843.

WEEDS. Lurking about every garden and every plowed field, hiding along roadsides, lying in wait behind hedges, a great army of wild weeds is always waiting the moment when the farmer or the gardener sits down to his well-earned rest.

Then, like the barbarian hordes that overran Europe centuries ago, they pour forth to the attack, sweeping over fields and flower beds, choking down, crowding out, destroying all the civilized plants that stand in their way.

They are well trained fighters, these weeds, hardened to their task by generations of starving in sandy and rocky soil, by long struggles against hot winds and driving colds. The fair fat vegetables and grains, the delicate flowers, accustomed to man's care and protection, can offer but feeble resistance.

And when the farmer or gardener rushes into the fray with poison liquids to squirt on his enemies, with hoes and rakes to grub up their roots, with every device of modern agricultural warfare, the wily weeds adopt tricky tactics. Some put down roots beyond the hoe's reach, where they wait patiently for a chance to spring up again, each little rootlet sending out a strong new weed. Others hasten early in the season to scatter their seeds broadcast so they will be plowed under, ready to sprout at the favorable moment. Some mature quickly and have large families of children before the nodding grain has ripened to seed. But the most dangerous of all are those that become spies, imitating the appearance of their domestic rivals. These are harvested with the grain or hay, and mingle their countless seeds with the true crop. In this way the weed seed is sowed with the good seed and revels in idle luxury, safe from attack. In a single pound of clover seed, for instance, no less than 14,000 seeds of 44 different weed species have been found.

The Spoiled Children of Mother Nature

A weed has been described as "a plant out of place," but that means out of place only so far as man is concerned. Mother Nature seems to favor these spoiled children in her family. They are the irrepressible bad boys of the vegetable kingdom, strong, vigorous, and healthy, always first to seize an opening, able to fight their own battles and elbow their way where they are not wanted, and survive under nearly all circumstances.

If they are a great nuisance to the farmer and gardener, they are often, on the other hand, intensely interesting to the plant lover. In almost every case weeds have developed some special apparatus or weapon which enables them to outwit or overcome their foes. The nettle has its stinging hairs, which drive off grazing stock; the dandelion has its white-winged barbed seeds, which travel far and fasten firmly; the hawkweed has its ground runners that creep out and take root on all sides of the parent plant; the burdock has its bristling seed pods with fish-hook points that cling to your clothing or sheep's wool and are carried far and wide; the tumble-weed goes rolling with the wind for miles scattering its seed as it goes; the black nightshade has its poison; the ladies' sorrel and jewel weed have a seed-shooting apparatus which snaps out the seeds like little pop-guns to quite a distance; the picturesque milkweed—so called from the milky juice which issues from the stem when broken—has rough-coated pods, and when these burst, clouds of lovely silky tufts bearing little flat brown seeds are wafted by the breeze far and wide over the countryside; and so on down the countless list.

There are a great number of beautiful flowering plants which, because they come up in the wrong places, are often called weeds by the farmer. Black-eyed Susans and the lovely New England asters are often considered weeds when they grow too abundantly in meadows.

Some weeds are annuals, dying in the winter and relying on their seeds to "carry on" the next spring. Some are biennials, storing up in their fleshy roots or leaves the food they have gathered in order to have an early start the second year, producing their seeds before the other plants can. Others are perennials, living through the coldest winters and springing up afresh year after year, unless pulled roots and all out of the ground. Purslane and ragweed are good examples of annuals; burdock and wild carrot, or Queen Anne's lace, are common biennials; while field sorrel and the Canada thistle are familiar perennials.

Those Troublesome Burrs

Among the weeds which carry burrs are the cockleburs, beggarlice, devil's pitchforks, and greenburs. Chief among the grasslike weeds are Johnson grass, crab grass, and switch grass. Other common weeds are the bindweed, or wild morning-glory, the smartweeds, the pigweeds, tumble weeds, chickweeds, peppergrass, wild mustard, partridge pea, lupine, plantains, cacti, thistles, pokeweed, sneezeweed, fleabane, goldenrod, madder, and toadflax.

The loco weed of the Western and Southern states is one of the most sinister of weeds. The name, the Spanish word for "crazy," is given to several species of plants belonging to the vetch family (akin to peas and beans), which affect the horses, cattle, and sheep

that eat them, in much the same way that the use of certain drugs affects human beings. The first effects of the weed are stimulating. Continued eating of it, however, leads to dizziness and nervous and muscular derangements. Locoed horses are apt to shy violently, or rear and fall backward. Death from exhaustion or starvation is the final outcome.

Here are some of the rules for the battle against the weed army: (1) If you see weeds coming up, do not allow them to ripen their seeds, but get rid of them while they are young. (2) Do not turn under the ground weeds which bear seeds. This only plants the seeds for next spring. (3) Be careful not to spread fresh stable manure on the soil. It often contains weed seeds. (4) Watch carefully every unfamiliar plant that comes up in your garden. It may be a dangerous weed.

WEEK. The division of the month into four weeks of seven days arose partly from the moon's phases (new moon, first quarter, full moon, last quarter), which are about seven days apart. The number seven was also regarded as sacred by the ancient Babylonians, among whom this division of time first arose. Even the Chinese and ancient Peruvians used the seven-day week. The biblical story in Genesis gives six days for the work of creation, with the seventh day as a day of rest—the Jewish Sabbath (Saturday). The Christian church adopted the first day of the week (Sunday), on which Christ arose from the dead, as its sacred day of rest.

The French Revolution attempted to introduce the "decade" of ten days in place of the week, but even in France the decade was used only for a few years.

WEEVILS. There are about 20,000 species of small beetles belonging to the weevil family, and nearly every one of them is a pest to man. The worst offender among these "snout beetles," as they are sometimes called, is the famous cotton-boll weevil—an insect only one-fifth of an inch long, which each year causes many millions of dollars' loss in the cotton-growing regions of the United States. The damage is done by the grubs (larvae) of the beetle, which hatch from eggs deposited in the buds and "bolls" (pods) of the cotton plant by the mother beetle. If they hatch in the buds, the grubs devour the interior and prevent the formation of bolls; if the buds escape, later generations of grubs may attack the bolls and destroy the fiber.

The boll-weevil is not a native of the United States; its original home is believed to have been Central America. In 1892 it crossed from Mexico into Texas, and advanced at the rate of about 20,000 square miles a year until it has spread over most of the cotton states. The weevil is estimated to have cost the Southern farmer $5,000,000,000 since coming into Texas.

Other members of the weevil family enormously increase this record of destruction. Each has some special plant picked out for its food. There are the acorn weevil, the hickory-nut weevil, the chestnut weevil, the plum weevil, the cherry weevil, etc., all of which are responsible for "wormy" nuts and fruits. The grain weevil attacks principally stored wheat. In addition we have the rice weevil, the corn weevil, the grape weevil, the sugar-cane weevil, the palm weevil (which infests coco palms), the strawberry weevil, the potato weevil, the clover weevil, the pea and bean weevils, each of which makes it almost impossible to grow these crops in certain regions.

On account of their small size and the fact that the larvae are usually hidden inside the plant or fruit beyond the reach of poison sprays, weevils are hard to control. The best way is to burn all infected plants, fruit, or grain, and to plow up or dig up all the ground in which these insects spend the winter. To combat the cotton-boll weevil, the United States Department of Agriculture recommends the removal of the plants from the field at the end of the season, early planting, the use of early maturing varieties, etc.

Weevils belong to the scientific group *Rhynchophora*, and most of them to the family *Curculionidae*.

WEIGHING MACHINES. The simplest form of weighing scale is based on the principle of balancing two loads from opposite ends of a horizontal bar. The Egyptians used such scales 4,000 or 5,000 years ago. They balanced a bar from a beam by a cord through the center, with two pans hanging from cords at either end of the bar. One pan held a known weight, the other the object to be weighed. The Romans improved on this with the *steelyard*, a scale-beam usually hung from a hook, with two unequal arms or levers. The article weighed is hung from the short arm, near the fulcrum, and a weight or counterpose is moved along the longer arm until a balance is reached. Markings on the long arm show the weight in ounces, pounds, tons, etc. (*see* Weights and Measures). The "knife edge," developed in the Middle Ages, is a fulcrum made of a wedge sharpened like a knife; this reduces friction between the beam and its support.

These simple devices are the basis of most modern scales. We have scales so delicate they register the weight of a human hair, or of the writing on a piece of paper; others are so massive they record the weight of a locomotive, or of a loaded freight car. The platform scales which weigh great loads are based on the compound lever—that is, a series of levers acting upon one another. The first successful platform scales were invented in 1830 by Thaddeus Fairbanks and his brother Erastus at St. Johnsbury, Vt., and ever since that town has been famous for its scales. The early Fairbanks scales had platforms supported on an A-shaped lever connected to a steelyard by a rod.

Delicate scales, called balances or chemical balances, are used to weigh gold, silver, precious stones, and drugs. Some are so sensitive they are kept in closed cases in which the temperature never varies.

On the common spring scales, the article weighed may be hung from a hook or placed in a pan below a spring, and the stretching of the spring registers the weight on a dial or a flat surface above. The underlying principle of this action is that of Hooke's law concerning the distortion of elastic substances, that the

strain (yielding) is proportional to the force applied. The spring stretches more as more weight is applied.

Some modern scales register the price of the article weighed. On these an indicator, set at the price per unit—ounce, pound, etc.—moves exactly as does the weight indicator. Other scales count small articles, such as nails or bolts, merely by assuming that the weight of a given number of pieces will hold good, no matter how many are weighed. Banks weigh gold coins, instead of counting them.

HOW LONG? HOW MUCH? WHAT *Does It* WEIGH?

WEIGHTS AND MEASURES. So natural does it seem to us to have exact standards of weights and other measures that it takes a strong effort of the imagination to picture conditions when men weighed gold, silver, and precious stones against dried grains of wheat "taken from the middle of the ear," and when they measured short lengths by grains of barley ("barleycorns") or the first joint of the index finger, and longer distances by the length of the human foot, by the distance from the elbow to the tip of the middle finger ("cubit"), by the pacing stride, or the day's journey. With the growth of commerce and progress in civilization such rough and ready measures were replaced by more accurate and uniform standards. In the days of the Roman Empire standard weights and measures were preserved in a Roman temple and served as standards for the whole civilized world. After the fall of the empire these standards were lost, and there ceased to be any uniformity of weights and measures. In the Middle Ages almost every town had its own standards of weights and measures, and there were even variations between those of one trade or gild and another. As late as the 18th century in Italy alone there were more than 200 units of length called the "foot." Conditions in England were about as bad until John Bird made standard yard-sticks in 1758.

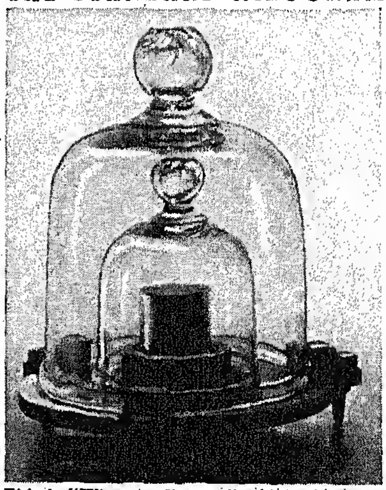
A good idea of the inconvenience caused by the lack of absolute and invariable standards is furnished by a German treatise on surveying of the 16th century, which instructs the surveyor to establish the length of a "rood" thus: "Stand at the door of a church on a Sunday and bid 16 men to stop, tall ones and small ones, as they happen to pass out when the service is finished; then make them put their left feet one behind the other, and the length thus obtained shall be a right and lawful rood to measure and survey the land with, and the 16th part of it shall be a right and lawful foot."

THE STANDARD METER

Preserved in the Bureau of Standards at Washington, D. C., is a metal bar, made of an alloy of platinum with 10 per cent iridium. It is "Standard International Meter No. 27," one of those made by the International Bureau of Weights and Measures. This bar is the standard for the United States, the ratio of the yard to the meter being legally defined as 3600 to 3937.

The names of many of our units indicate the rude measurements from which they originated. "Mile" is from the Latin *mille passum*, meaning "1,000 paces," each pace being about 5 feet—a double step. The "furlong" meant originally a "furrow long"—the length of a furrow in the usual acre strip of the medieval manorial system. The "rod," "perch," or "pole" represents the length of the ox-goad used by the plowman to measure his first furrow. The "yard" (literally, a stick or rod) is supposed to represent the length of a man's arm. The "foot" tells its own origin. "Inch" is from the Latin *uncia*, "twelfth part." "Acre" is from a word meaning "field."

THE STANDARD KILOGRAM



This is "Kilogram No. 20," which is kept in Washington, D. C. It is one of the standard international kilograms adopted by the International Bureau of Weights and Measures. The ratio of the pound to the kilogram is fixed by Act of Congress as 1 to 2.2046.

The system of commercial weights and measures used in the United States is based on that which grew up in England through age-long custom as modified by successive royal and parliamentary enactments. The standard bushel kept in the town hall of Winchester and known as the "Winchester bushel" (2,150.42 cubic inches) is the bushel measure which prevails throughout most of the United States and Canada; but Great Britain in 1826 established an "imperial bushel" of 2,218.192 cubic inches in its place. The English yard was established by Henry I as the distance from the point of his nose to the end of his thumb. The inch was declared in 1224 to be the length of three dry barleycorns laid end to end. The use of the "barleycorn" as a unit of measure still survives in shoe measurements, which are numbered by thirds of an inch or "barleycorns" in a system of 13's. The pound, roughly equivalent to the old Roman *libra* (which gives us the

abbreviation "lb."), was long defined as the weight of 7,680 grains of wheat; hence the "grain" is still the smallest unit of weight in our common systems. In the reign of Henry VIII the avoirdupois pound of 7,000 grains came into use. The "troy" pound (derived from Troyes, France, an important trading center in the Middle Ages) of 5,760 grains became the unit for weighing bullion and jewels, as it still is. The "pennyweight," equal to 24 grains in the troy system, was originally the weight of the English penny.

Congress has the constitutional right in the United States to fix the standards of weights and measures, but it has rarely exercised this right, preferring to leave such legislation to the states. Hence there is considerable variation in some common standards. The "ton," for example, is usually the commercial short ton of 2,000 pounds, but in some states the statutory ton of certain commodities is defined as a definite number of cubic feet or as a certain number of bushels of fixed weight. The long ton of 2,240 pounds —the historical ton in England—is prescribed in some states for certain commodities. Hence the "hundredweight"—(the one-twentieth part of a ton) is sometimes 100 pounds, sometimes 112. The short ton of 2,000 pounds is largely used in fixing transportation rates. There is also great variation in the definitions of the gallon, the bushel, and the barrel.

For its own use, however, the Federal government has had to fix certain standards, which generally prevail throughout the country. Since 1893 the yard and pound and their parts have been defined in terms of a standard meter and kilogram, kept at the Bureau of Standards in Washington. The barrel and bushel have also been standardized, to a certain extent, by federal acts making it unlawful to sell or ship fruits, vegetables, etc., in containers which do not conform to established specifications.

Because of the irregularities and inconvenience of the present systems of weights and measures and the advantages of having an international system, there has long been a powerful movement in favor of adopting the metric system, which is now used for scientific work in all countries, and for all purposes in most of the countries of Europe (*see* Metric System).

There is a tendency to drop one or more units of this oddly built system of measurements in practical work. Thus merchants measure cloth by the yard, and express smaller quantities either in inches or in fractions of the yard, ignoring the foot. Builders use the foot and the inch, ignoring the yard. Surveyors and engineers quite commonly ignore the inch, using decimal fractions of the foot instead.

The following tables show the chief units of weight and measure used in the United States and other English-speaking countries. They also give some of the units still used in foreign countries, in addition to the metric system. There are also tables for the conversion of metric weights and measures to those of the United States, as well as tables of miscellaneous measures.

TABLE OF COMMON WEIGHTS AND MEASURES

Long Measure

1000 mils = 1 inch (in.)
12 inches = 1 foot (ft.)
3 feet = 1 yard (yd.)
5½ yards (16½ ft.) = 1 rod
40 rods = 1 furlong
8 furlongs (5280 ft.) = 1 mile
3 miles = 1 league

Note.—While the English and American mile is 1760 yards, other countries have differing measures; the Swedish mile is 1700 yards; Russian, 1155 yards; Italian, 1614 yards; Scotch, 1984 yards; Irish, 2240 yards; German short mile, 5285 feet; German long mile, 8805 feet.

Square Measure

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)
30¼ square yards = 1 square rod
160 square rods = 1 acre
640 acres = 1 square mile
36 square miles = 1 township

Note.—A "square" in building trades, etc., denotes 100 square feet for flooring, shingles, etc.

Mariners' Measure

6 feet = 1 fathom
120 fathoms = 1 cable length
8.444 cable lengths (6080 ft.) = 1 nautical mile
3 nautical miles = 1 marine league
1.15 U. S. miles = 1 nautical mile

Note.—A geographical mile is 1′ of the arc on the earth's surface at the equator. A knot is a speed measurement the equivalent of a nautical mile.

Surveyors' Measure

7.92 inches = 1 link
25 links = 1 rod
4 rods (66 ft.) = 1 chain
10 chains = 1 furlong
8 furlongs = 1 mile
1 square mile = 1 section

Cubic Measure

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)
27 cubic feet = 1 cubic yard (cu. yd.)
128 cubic feet = 1 cord (wood or stone)
231 cubic inches = 1 U. S. gallon
277.27 cubic inches = 1 British imperial gallon
2150.4 cubic inches = 1 U. S. bushel

Note.—A rick or strand is 8 feet by 4 feet by 1⅓ feet. A masonry perch varies from 16½ to 25 cubic feet. A cubic foot of water weighs about 62.5 pounds.

Liquid Measure

4 fluid ounces (fl. oz.) = 1 gill
4 gills = 1 pint (pt.)
2 pints = 1 quart (qt.)
4 quarts = 1 gallon (gal.)
9 gallons = 1 firkin
31½ gallons = 1 barrel (bbl.)
2 barrels = 1 hogshead

Note.—A gallon in most states occupies 231 cubic inches. A gallon of water weighs about 8⅓ pounds.

Dry Measure

2 pints = 1 quart
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)
2150.42 cubic inches = 1 bushel

Note.—One barrel of flour contains 196 pounds. Various states have established different cubic contents or weights for the bushel of various commodities.

Troy Weight

24 grains = 1 pennyweight (dwt.)
20 pennyweights = 1 ounce
12 ounces = 1 pound

Avoirdupois Weight

$437\frac{1}{2}$ grains = 1 ounce (oz.)
16 ounces = 1 pound (lb.)
100 pounds = 1 hundredweight (cwt.)
2000 pounds = 1 short ton (S. T.)
2240 pounds = 1 long ton (L. T.)

Note.—The stone of 14 pounds is a common English measure of weight, likewise the long hundredweight of 112 pounds.

Apothecaries' Weight

20 grains = 1 scruple
3 scruples = 1 dram
8 drams = 1 ounce
12 ounces = 1 pound

Counting

12 things = 1 dozen (doz.)
13 things = 1 baker's dozen
12 dozen = 1 gross (gr.)
12 gross = 1 great gross
20 things = 1 score

Angular Measure

60 seconds (″) = 1 minute (′)
60 minutes = 1 degree (°)
360 degrees = 1 circle or circumference

Paper Measure

24 sheets = 1 quire
500 sheets (formerly 480) = 1 ream
2 reams = 1 bundle
4 bundles = 1 case

Note.—The case varies, sometimes the nearest quantity to 500 pounds is taken as a case. Paper weights, with few exceptions such as writing paper, are calculated on a basis of reams whose sheets measure 25x38 inches.

TABLE OF CONVERSION EQUIVALENTS

Units of Length—U. S. to Metric

1 inch = 25.4 millimeters (mm)
1 inch = 2.54 centimeters (cm)
1 foot = 0.3048 meter (m)
1 mile = 1609.347 meters
1 mile = 1.6093 kilometers (km)

Units of Length—Metric to U. S.

1 millimeter = 0.03937 inch
1 centimeter = 0.3937 inch
1 meter = 39.37 inches
1 kilometer = 0.62137 mile

Units of Area—U. S. to Metric

1 square inch = 6.4616 sq. centimeters (cm^2)
1 square foot = 929.03 cm^2 = 0.0929 m^2
1 square yard = 8361.307 cm^2 = 0.836 m^2
1 acre = 4046.87 m^2 = 0.4047 hectare (ha^2)

Units of Area—Metric to U. S.

1 square centimeter = 0.1549997 square inch
1 square meter = 10.764 square feet
1 hectare = 107,638.7 square feet = 2.471 acres

Units of Volume—U. S. to Metric

1 cubic inch = 16.387 cu. centimeters (cm^3)
1 cubic inch = 0.01639 cu. decimeter (dm^3)
1 cubic foot = 28.317 dm^3
1 cubic foot = 0.028317 cubic meter (m^3)
1 cubic yard = 764.559 dm^3
1 cubic yard = 0.764559 m^3

Units of Volume—Metric to U. S.

1 cubic centimeter = 0.061023 cubic inch
1 cubic decimeter = 61.02338 cubic inches
1 cubic decimeter = 0.03531 cubic foot
1 cubic meter (stere) = 35.31445 cubic feet
1 cubic meter = 1.30794 cubic yards

Capacity (Liquid)—U. S. to Metric

1 minim = 0.06161 milliliter (ml)
1 fluid dram = 3.6966 ml = 0.003697 liter (l)
1 fluid ounce = 29.573 ml = 0.02957 l
1 gill = 118.29 ml = 0.11829 l
1 pint = 473.167 ml = 0.4732 l
1 quart = 946.33 ml = 0.9463 l
1 gallon = 3785.33 ml = 3.785 l

Capacity (Liquid)—Metric to U. S.

1 milliliter = 16.2311 minims
1 milliliter = 0.27052 fluid dram
1 milliliter = 0.033815 fluid ounce
1 liter = 8.45368 gills = 2.1134 pints
1 liter = 1.0567 quarts = 0.2642 gallon

Capacity (Dry)—U. S. to Metric

1 pint = 0.5506 liter = 0.05506 dekaliter (dk)
1 quart = 1.101198 liters = 0.11012 dk
1 peck = 8.80958 liters = 0.88096 dk
1 bushel = 35.2383 liters = 3.52383 dk

Capacity (Dry)—Metric to U. S.

1 liter = 1.816 pints = 0.908 quart
1 liter = 0.1135 peck = 0.028378 bushel
1 dekaliter = 18.162 pints = 9.08102 quarts
1 dekaliter = 1.13513 pecks = 0.28378 bushel

Units of Mass—U. S. to Metric

1 grain = 64.7989 milligrams (mg) = 0.0648 gram (g)
1 scruple = 1295.978 mg = 1.29598 g
1 pennyweight = 1555.17 mg = 1.55517 g
1 avoirdupois dram = 1771.85 mg = 1.77185 g
1 apothecaries' dram = 3887.935 mg = 3.8879 g
1 avoirdupois ounce = 28349.527 mg = 28.3495 g
1 apothecaries' or troy ounce = 31103.481 mg = 31.1035 g
1 apothecaries' or troy pound = 373.242 g = 0.37324 (kg)
1 avoirdupois pound = 453.592 g = 0.45359 kg
1 short ton = 907.185 kg = 0.9072 metric ton
1 long ton = 1016.047 kg = 1.016 metric tons

Units of Mass—Metric to U. S.

1 milligram = 0.0154 grain
1 gram = 15.432 grains
1 gram = 0.77162 scruple
1 kilogram = 35.274 avoirdupois ounces
1 kilogram = 32.15 apoth. or troy ounces
1 kilogram = 2.679 apoth. or troy pounds
1 kilogram = 2.2046 avoirdupois pounds
1 metric ton = 2204.62 avoirdupois pounds
1 metric ton = 1.102 short tons = 0.9842 long ton

MISCELLANEOUS UNITS OF WEIGHTS AND MEASURES

1 atmosphere (pressure) = 14.7 lbs. per sq. in.
1 atmosphere = 34 ft. head of water
1 atmosphere = 760 mm of mercury
Absolute zero = −273° C = −459.4° F.
1 degree C = $\frac{5}{9}$ (F. − 32)
1 degree F. = ($\frac{9}{5}$ C) + 32
1 horse-power (Hp) = 550 foot-pounds per second
1 horse-power = 746 watts = 0.746 kilowatt
1 kilowatt (kw) = 1.34 horse-power
1 international carat = 200 milligrams (gem weight)
1 point (type size) = $\frac{1}{72}$ inch = 0.01389 in.
1 light year = 5.9×10^{12} miles
1 nail = $2\frac{1}{4}$ inches (cloth measure)
1 finger = $4\frac{1}{2}$ inches (cloth measure)
1 span = 9 inches (cloth measure)
1 ell = 27 to 48 inches (variable)
1 hand = 4 inches (measuring horses)
1 cubit (biblical) = 18 inches
1 board foot = 144 cubic inches

U. S. Official Weights of Barrel

Wheat, barley, rye flour = 196 pounds
Rosin, tar, pitch (gross) = 500 pounds
Fish, pickled (net) = 200 pounds
Lime (net) = 200 pounds
Cement (4 bags) (net) = 376 pounds

U. S. Official Weights of Bushel

Wheat, beans, peas, potatoes = 60 pounds
Rye, corn, linseed, maslin (mixed grain) = 56 pounds
Barley, buckwheat = 48 pounds
Onions = 47 pounds
Rough rice = 45 pounds
Malt = 34 pounds
Oats = 32 pounds
Peanuts, green, in shell = 22 pounds
Castor beans = 50 pounds

Common Household Measure

3 teaspoons (t.) = 1 tablespoon (tb.)
1 tablespoon = ½ fluid ounce
16 tablespoons = 1 cup
1 cup = 8 fluid ounces
2 gills = 1 cup
1 cup = ½ liquid pint
1 cup granulated sugar = ½ pound
1 cup flour = ¼ pound
1 cup chopped meat = ½ pound
1 cup lard = ½ pound
1 cup rice = ½ pound
1 cup corn meal = 5 ounces
1 cup raisins = 6 ounces
1 cup currants = 6 ounces
1 cup dry crumbs = 2 ounces

FOREIGN WEIGHTS AND MEASURES

The following countries use the metric system: Argentina, Belgium, Bolivia, Brazil, Bulgaria, Chile, Denmark, Ecuador, Finland, France, Germany, Haiti, Honduras, Hungary, Italy, Mexico, Netherlands, Nicaragua, Norway, Paraguay, Portugal, Rumania, Russia, Santo Domingo, Spain, Sweden, Switzerland, Uruguay, Venezuela. Some of them have in common use other weights and measures, which are included in the following list:

Brazil

1 libra = 1.012 pounds
1 arroba = 32.28 pounds
1 quintal = 129.54 pounds
1 oitava = 55.34 grains

China

1 catty (*kin*) = 16 taels (*liang*) = 1⅓ pounds
1 picul (*tan*) = 100 catties = 133⅓ pounds
1 tou = 1 to 1½ gallons
1 li = 654 yards

England

1 imperial bushel = 1.0315 U. S. bushels
1 imperial gallon = 1.2 U. S. gallons
1 tun = 302.5 gallons
1 cental = 100 pounds
1 picul = 133⅓ pounds
1 quintal (Newfoundland) = 112 pounds

Greece

1 Ionian pound = 1 pound, avoirdupois
1 Venetian pound = 1.058 pounds
1 oka = 2.822 pounds

Ancient Greece

3 palms = 1 span
2 spans = 1 cubit = 18.24 inches
4 cubits = 1 fathom
400 cubits = 1 stadia = 600 feet
1 talent = 93.65 pounds

Japan

1 kin = 1.323 pounds
1 kwan = 8.67 pounds
1 sun = 1.93 inches
1 shaku = 11.93 inches
1 ken = 5.95 feet
1 ri = 2.44 miles
1 cho = 2.44 acres
1 koku = 39.7 gallons

Mexico

1 libra = 1.014 pounds
1 arroba = 25.357 pounds
1 vara = 32.9 inches

Paraguay

1 cuadra = 97 yards
1 square cuadra = 2 acres
1 square legua = 7.5 square miles

Peru

1 ounce = 1.014 ounces
1 libra = 1.014 pounds
1 quintal = 101.44 pounds
1 arroba = 6.7 gallons
1 arroba = 25.36 pounds
1 vara = 33.37 inches

Ancient Rome

1 digitus = .73 inch
1 Roman foot = 0.973 foot
1 gradus = 2.42 feet
1 actus = 116.4 feet
1 Roman mile = 5000 Roman feet = 4865 feet
1 as = .72 pound
1 uncia = 420 grains
12 unciae = 1 libra
125 librae = 1 talent
1 bes = .48 pound
1 denarius = 60.16 grains
1 obolus = 8.77 grains
1 scrupulum = 17.53 grains

Russia

1 verst = 3500 feet = .6629 mile
1 dessiatine = 2.7 acres
1 pood = 36.07 pounds
1 vedro = 3.25 gallons
1 chetvert = 5.77 bushels
1 sazhen = 7 feet
1 arshin = 28 inches
1 funto = 0.90 pound

Spain

1 quintal = 220.4 pounds
1 libra = 1.014 pounds
1 arroba (wine) = 3.5 gallons
1 arroba (oil) = 2.75 gallons

WEIMAR (*vī'mär*), GERMANY. In the quiet little city of Weimar, full of memories of Goethe and Schiller and but little touched by the bustle of modern industry, met the constitutional convention which in 1919 framed the new republican constitution for Germany and marked a new epoch in its history. Here 423 delegates, including 37 women, elected by universal, direct, and equal suffrage, met and adopted a constitution which gave to the 60,000,000 German people, men and women alike, regardless of rank or birth, equality before the law, personal liberty, and equal economic opportunity.

Weimar, the capital of the recently formed German state of Thuringia, has well been called "the poets' city," for wherever we go we find reminders of the great men of letters who once frequented the narrow winding streets of the quaint old town, or trod the grassy paths along the pleasant river Ilm. The houses where Goethe and Schiller lived and wrote are preserved with loving care, and in a noble monument

before the theater these two friends, the two greatest figures in German literature, are represented standing side by side. For nearly 40 years Weimar was the home of Franz Liszt, the composer and pianist. There are museums, art galleries, and a number of schools, but few industries. The city lies nearly at the center of Germany. Population, about 45,000.

WELDING. To build ships and skyscrapers and bridges by melting their parts together into a single solid structure is a dream that has already been partly realized. For that is what welding means—the fusion of two pieces of metal at their point of contact, making a joint that is sometimes stronger than the parent metal itself.

You have perhaps seen a blacksmith welding two pieces of iron or steel. He first heats the ends to be joined until they are comparatively soft and semi-fused. Then, after dusting them with a flux, such as borax, to remove impurities from their surface, he hammers them into a union.

This, the oldest form of welding, has largely given way to cheaper and quicker processes. These include gas welding by the hydrogen and oxy-hydrogen processes (*see* Hydrogen) and the even more familiar oxy-acetylene process (*see* Acetylene). Gas welding is extensively used for rails, locomotives, pipes, and in many forms of structural and repair work.

In resistance-welding, one of the forms of electric welding, the pieces of metal are pressed together while a large current of electricity passes through them. The higher resistance to this current at the joint causes heat sufficient to produce fusion. The intense heat of the electric arc is applied to welding by several different methods. Usually the arc is "struck" between a welding rod and the joint. The rod, made of some suitable alloy, and the edges of the metals to be welded both melt and run together into the joint like solder. The rods are often coated with chemicals that act as fluxing agents or deoxidizers; for one of the great obstacles to welding is the fact that oxides tend to form on the surfaces of hot metals, preventing proper union. Blasts of various gases are sometimes used to produce protective vapor or flame around the weld.

In "atomic hydrogen" welding, the weld does not form a part of the electrical circuit. A jet of ordinary hydrogen is forced into an arc between two tungsten electrodes and breaks up into single hydrogen atoms. This reaction greatly intensifies the heat, and tends to prevent the formation of harmful compounds. On heavy, cumbersome work "thermit" welding has been used extensively. (*See* Aluminum.)

The chief problem in skyscraper, ship, and bridge welding is the accurate and fool-proof inspection of welds to determine when they are sound and strong. X-rays will usually detect flaws in "butt welds," that is, those where the metals butt together end to end, but they often fail to reveal bad joints in "lap welds," where the metals overlap. The electric or magnetic characteristics of welds in steel and iron sometimes indicate any weakness that may be present. Perhaps the best practical method of testing welds is to measure their acoustic properties.

WELLAND SHIP CANAL. Niagara Falls block the natural communication between Lakes Erie and Ontario by the Niagara River. The Welland Ship Canal, however, overcomes this obstacle by cutting across the narrow isthmus between the lakes, on the western or Canadian side of the river. It is an essential link in the great waterway from Duluth or Chicago to the Atlantic Ocean (*see* Great Lakes). Through it passes an enormous tonnage of ore, coal, grain, wood pulp, oils, and manufactured goods. There are no toll charges for Canadian and American vessels.

The present canal was officially opened in 1932. It replaces the old canal and follows essentially the same route. Port Colborne remains the Lake Erie terminus, but at the Lake Ontario end the terminus was changed from Port Dalhousie to Port Weller, shortening the route by about two miles.

The canal is remarkable in that it lifts vessels about 326 feet—the difference in level between Lake Erie and Lake Ontario—in a distance of only 27.6 miles. The Panama Canal, nearly twice as long, has a lift of but 85 feet. The Welland Canal has seven locks, each with a lift of about 46½ feet. Each lock is 859 feet long, 80 feet wide, and 30 feet deep. The reaches between the locks are 25 feet deep, but may be dredged to 30 feet. At Thorold a series of three twin locks permits the passage of ships in opposite directions. An eighth guard lock at the Lake Erie entrance keeps the water level between Port Colborne and Thorold at a regulated height, enabling vessels to pass in and out of the canal without delay from the constantly changing level of the lake. This lock is 1,380 feet long, one of the largest in the world. The total cost of the canal at the time of its opening was more than $131,000,000.

The first Welland Canal was built in 1829, with 40 small wooden locks for ships of not over 7½-foot draft. These were rebuilt in 1845, to reduce the number to 27. In 1887 they were made 270 feet long, 45 feet wide, and 12 feet deep, and deepened later to 14 feet.

WELLINGTON, DUKE OF (1769–1852). In the same year that Napoleon Bonaparte, the conqueror of Europe, was born in the little island of Corsica, another boy, Arthur Wellesley, who rose to be Duke of Wellington through his conquest of the conqueror, was born in Ireland. He was the fourth son of an Irish nobleman, the earl of Mornington.

We know very little about the early life of Arthur Wellesley (or Wesley, as the name was first written). He was a homely lad and evidently took very little interest in his books, either at the preparatory school at Chelsea or at Eton which he attended for a time. His mother, who never loved the boy, once said that "her ugly boy, Arthur, was fit food for powder and nothing else." Accordingly he was sent to the military school at Angers, France, where for a year he associated with French boys against whom he was later to fight.

At the age of 17 he entered the English army, and through the influence of his older brother, who was a member of the British House of Commons and of the government, his rise was rapid. By the evil custom of purchasing commissions he became lieutenant-colonel at the early age of 22, but his later achievements justified his advancement. In the hill country of India, from 1796 to 1805, he conquered hostile chiefs who had sworn to drive the English into the sea, and whose forces far outnumbered his own. And by the treaties which closed the war against these Mahratta tribes, Wellington showed himself a master of Indian statesmanship and diplomacy, as well as an expert on the field of battle.

WELLINGTON
The Conqueror of Napoleon

In 1805 he quitted India for the larger field of the war with Napoleon in Europe. In his first campaign in the Spanish peninsula, which the French had overrun, he won a notable victory, the fruits of which were lost by the incompetence of his superior officers. The next year (1809) he came back to the peninsula as commander-in-chief, and in five momentous years drove Napoleon's well-trained generals from the Spanish peninsula. In 1814 he was fighting on French soil when Napoleon's first abdication brought peace. Finally on the field of Waterloo, with the aid of the Prussian general Blücher, he crowned his military career by defeating Napoleon himself.

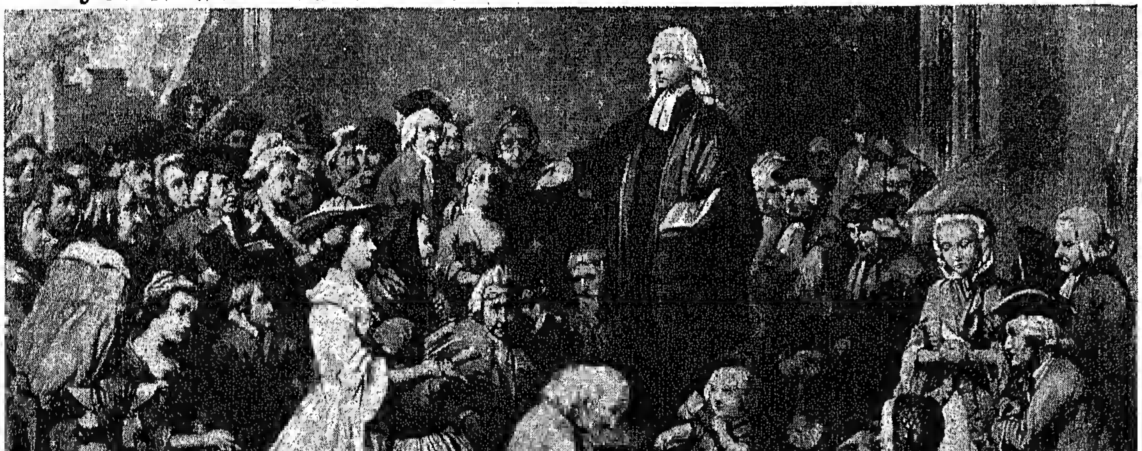
Honors, rewards, and gifts were now heaped upon the successful general, who was already created the first Duke of Wellington. As commander of the international army which occupied France until the terms of the peace treaty were fulfilled he had immense power, and for years he was one of the most influential men in all Europe.

Wellington proved less successful as statesman than as general, although for two years (1828–30) he was prime minister of Great Britain. He was an aristocrat who failed to read aright the signs of the times. The demand for the reform of parliament and the extension of the right to vote he thought was the work of a few uneasy agitators. Because he opposed the demand for reform he was forced to resign as prime minister and had to protect his house from the mob.

When the angry passions of the times had passed, people recognized that though Wellington was not always an able statesman he was a faithful and conscientious one, who always worked for what he believed to be the good of the nation. That and his great military glory made him in his old age venerated and beloved by all, the hero soldier of Great Britain as Nelson was the hero sailor.

Wesley, John (1703–1791). In the early part of the 18th century in Oxford, England, there gathered about John Wesley, then a young curate, and his brother

JOHN WESLEY PREACHING AT AN OPEN-AIR MEETING



When Wesley began to preach the doctrines of Methodism he found the doors of the churches closed against him. At first, he said: "I could scarcely reconcile myself to this strange way of preaching . . . . having been all my life (till very lately) so tenacious of every point relating to decency and order, that I should have thought the saving of souls almost a sin, if it had not been done in a church." But it was not for long that he hesitated and for the greater part of his active preaching career he held meetings outdoors where all kinds of people thronged to hear his message.

Charles, a student at Christ Church College, a group of young men who came to be known as the "Holy Club." Their strict lives and methodical ways led other students to call them "Methodists." Thus the great denomination which Wesley founded got its name.

John Wesley was born at Epworth, Lincolnshire, where his father was a rector of the Church of England. He was educated at Oxford, ordained a deacon in the church in 1725, and two years later became his father's curate, or assistant. In 1735, accompanied by his brother, he went to America as missionary to Georgia. During the stormy voyage he was deeply impressed by the calm faith of some fellow passengers, a group of Moravians from Austria. He studied their doctrine, and, while attending a Moravian meeting in London after he returned, he felt his heart "strangely warmed" with faith in the saving power of Christ. He began preaching his new faith, and when he found the churches closed against him joined George Whitefield, a celebrated revivalist, in holding open-air meetings. Wesley's energy was amazing. He traveled about 5,000 miles a year and preached about 15 sermons a week. In spite of opposition and persecution, the meetings were attended by thousands and the movement spread rapidly. Wesley organized his converts into bands for prayer and church societies, appointed leaders to act as lay pastors, and finally ordained or commissioned preachers. This amounted to a break with the Church of England, although it was not recognized as such by Wesley himself.

In addition to the work of preaching and organizing, John Wesley was an active helper in social and charitable movements and wrote a number of works on religious subjects. His 'Journal', which gives an account of his life and work, has been called "the most amazing record of human exertion ever penned by man." He was as methodical in his private life as in religion, regularly retiring at ten and arising at four.

CHARLES WESLEY (1707–1788), who was associated with his brother in religious work, is best known as a hymn writer. He wrote about 6,000 hymns, many of which remain favorites in Protestant churches. Among the best known are 'Jesus, Thy Robe of Righteousness' and 'Blow Ye the Trumpet, Blow'.

Where EUROPE *Found* AMERICA—*The* WEST INDIES

Extent.—About 100 islands, with hundreds of islets and keys, stretching over about 2,100 miles. Area, about 92,000 square miles. Population (partly estimated), about 13,370,000.

Surface and Climate.—Hilly to mountainous (Loma Tina, Haiti, 10,300 feet); marine tropical climate, dominated by trade winds; mean temperature range, 60°F. (January, in the north) to 95° (August); heaviest rains, May to November.

Geographic Divisions.—Greater Antilles (81,600 square miles; population, 11,545,000), comprising Cuba, Hispaniola, Jamaica, Puerto Rico. Lesser Antilles (6,000 square miles; population, 1,765,000), comprising Leeward Islands, Windward Islands, South American coastal islands. Bahamas (4,400 square miles; population 60,000).

Principal Products.—Sugar, molasses, and rum (about two-fifths of total value; leading producers, Cuba, Jamaica, Puerto Rico, Haiti). Petroleum and its products (one-fourth; Curaçao, Trinidad). Tobacco (one-tenth; Cuba, Puerto Rico). Coffee (one-twentieth; Puerto Rico, Haiti). Fruits, cocoa, asphalt (Trinidad), cotton, spices, arrowroot, logwood.

Exports.—Total annual value, normally about $500,000,000. From independent republics, about one-third; from Netherlands Indies, one-third; from United States possessions, one-fifth; from British colonies, one-eighth; from French colonies, one thirty-third. To United States, about one-half; to Great Britain, one-fifth; to France and the Netherlands, one twenty-fifth each.

Imports.—Total annual value, normally about $500,000,000. To independent republics, one-fourth; to Netherlands Indies, one-third; to United States possessions, one-fourth; to British colonies, one-seventh; to French colonies, one-fortieth. From United States, about one-half; from Venezuela, one-fourth; from Great Britain, one-sixteenth; from Canada, one-fortieth; from all other countries, about one-seventh.

WEST INDIES. When Columbus sailed west in 1492, he found a chain of beautiful tropical islands, inhabited by copper-colored natives. Altogether he made three voyages among these islands, seeking the mainland of Asia; and he died thinking that he had reached "the islands of the Indies."

We still call these islands the Indies, but we add the word "West" to distinguish them from the East Indies of Asia. Another name, inherited from Columbus' time, is "the Antilles." Medieval geographers had used this term (or "Antilia") for islands which were supposed to exist in the western ocean. Columbus, they thought, merely had found these islands.

The very names suggest romance and adventure; and from Columbus' day to ours, the islands have justified this reputation. They are charged with memories of many fierce wars fought to possess them, of the bloody deeds of pirates, and of lordly plantations; and they bear old dark stains of slavery. Today they are vital outposts in the defense of the United States and a valuable source of trade. They also give thousands of tourists a delightful escape from winter.

The West Indian islands are the tops of a mountain chain which sank ages ago, leaving only the higher peaks and plateaus standing above the sea. This chain runs roughly north from South America about 600 miles, then curves to the westward for about 1,500 miles more. A similar span of distance in the United States would reach from the tip of Florida to about Atlanta, Ga., then west to about Santa Fe, N.M.

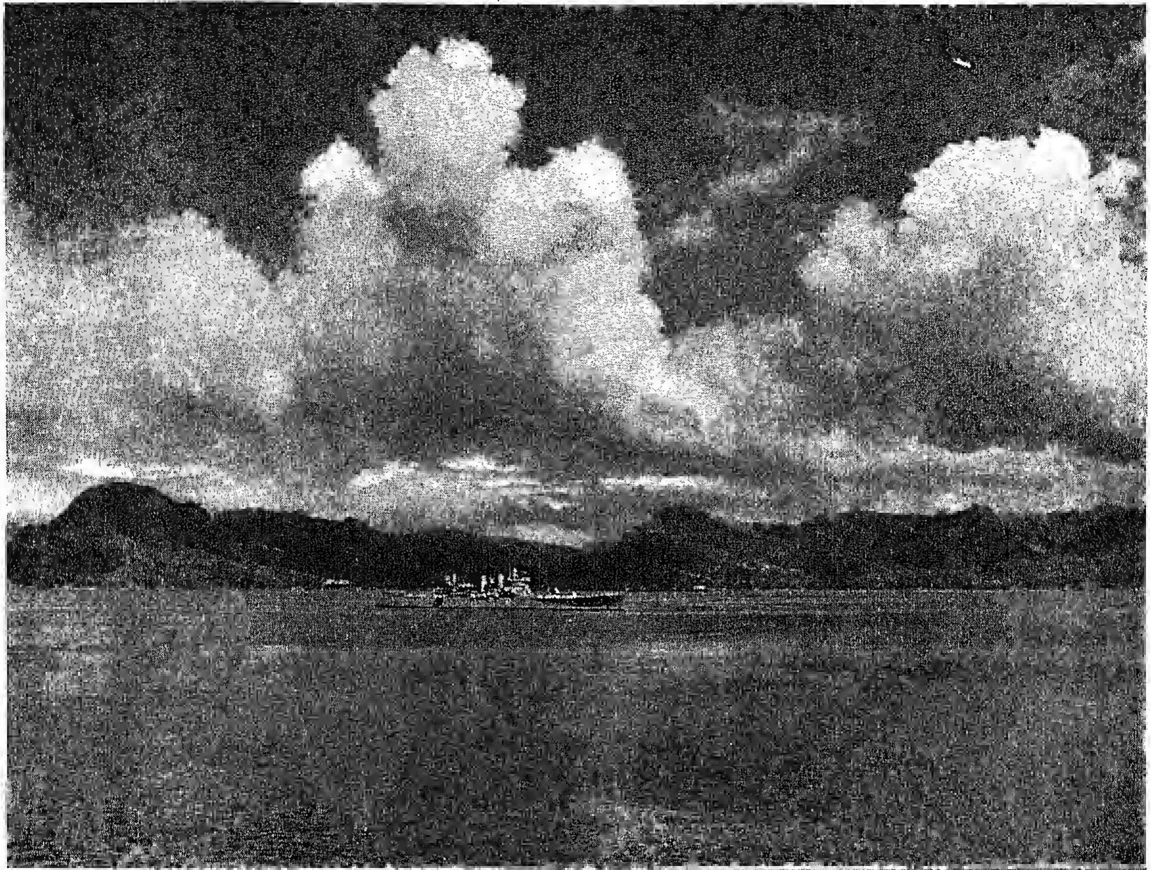
The southern end of the chain, the island of Trinidad, was once part of an old South American coast. From here north to the Virgin Islands the peaks are volcanic cones, some of them still active at intervals. The larger islands farther to the north and west are largely limestone, with some granite and a few extinct volcanoes. The most northerly group, the Bahamas, are probably coral-capped extinct volcanoes.

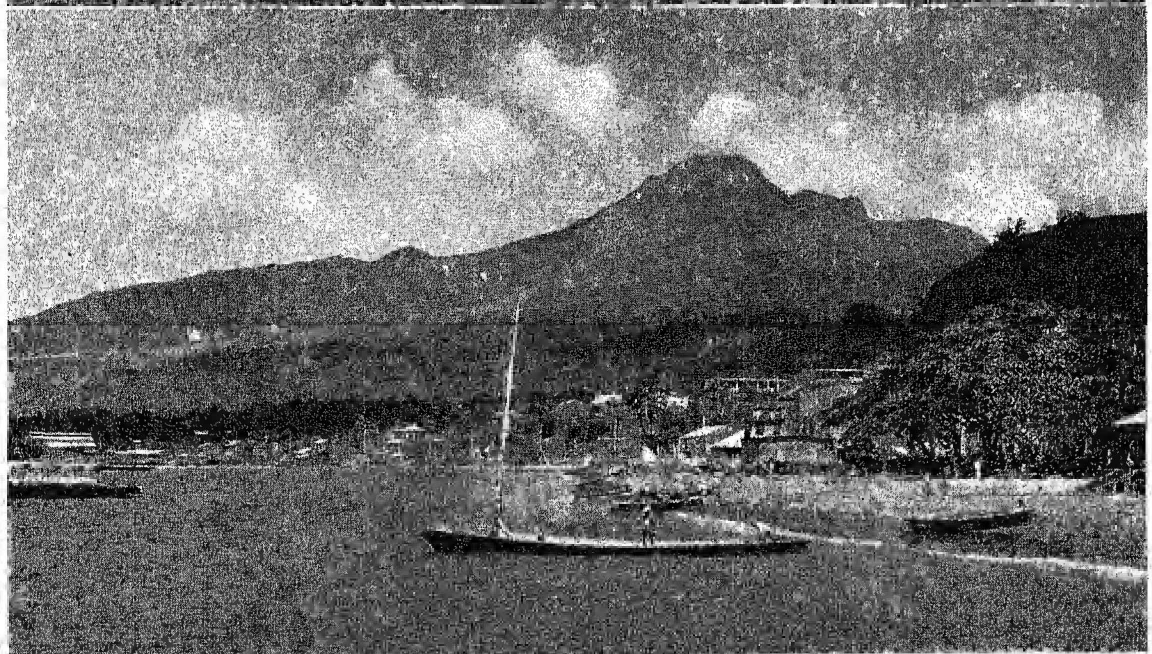
Strategic Importance of the Islands

Most of the islands are within 30 miles or less of each other; only three straits or "passages" are as much as 100 miles wide. Hence the West Indies have been convenient steppingstones between North and South America, for plant and animal life, for Indians, and for the early white settlers.

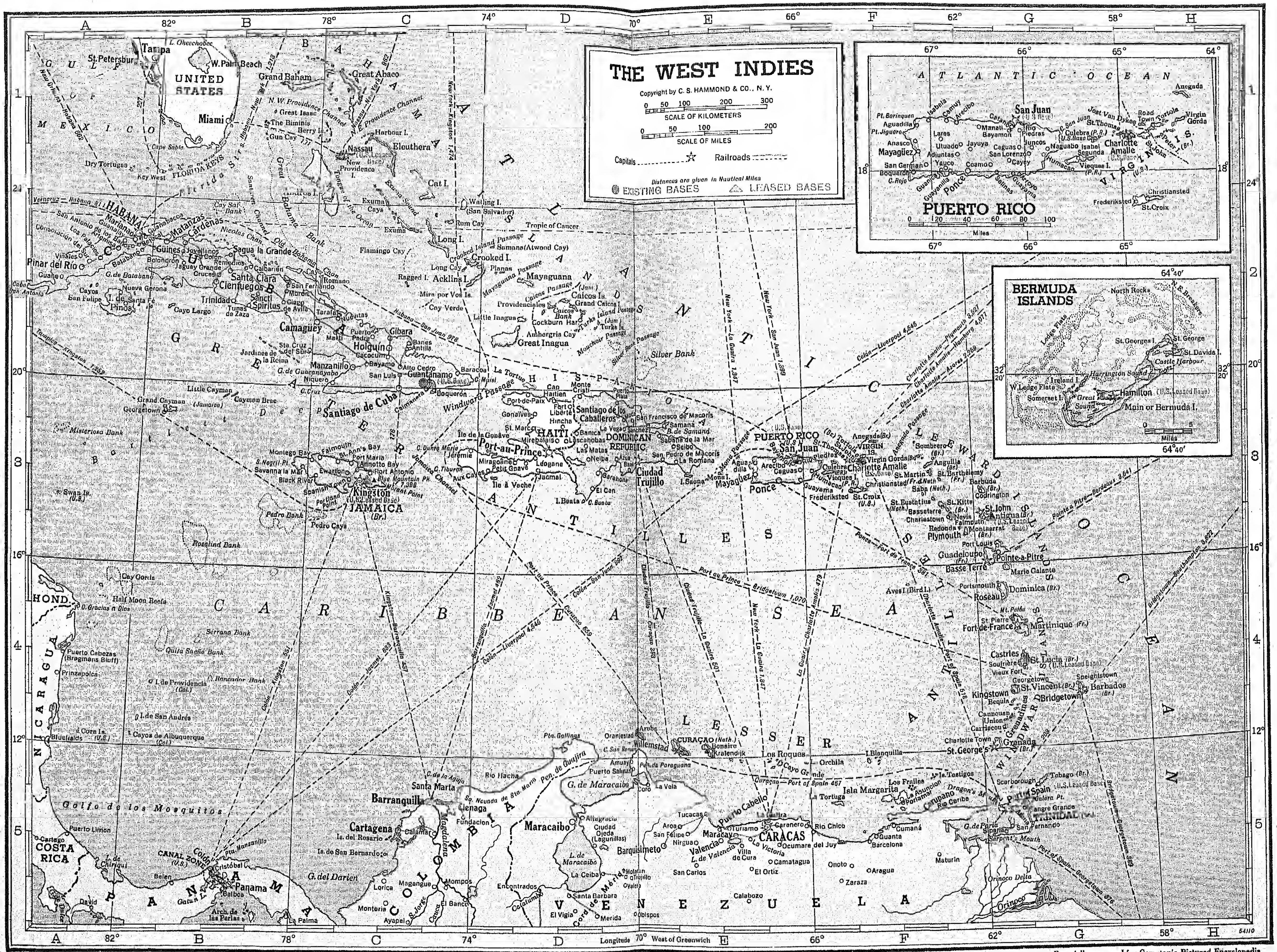
But the islands serve also as a screen between the Atlantic Ocean on the east and the Caribbean Sea and the Gulf of Mexico on the west. No vessel from Europe

ISLES OF ENCHANTMENT—TWO OF THE WEST INDIES



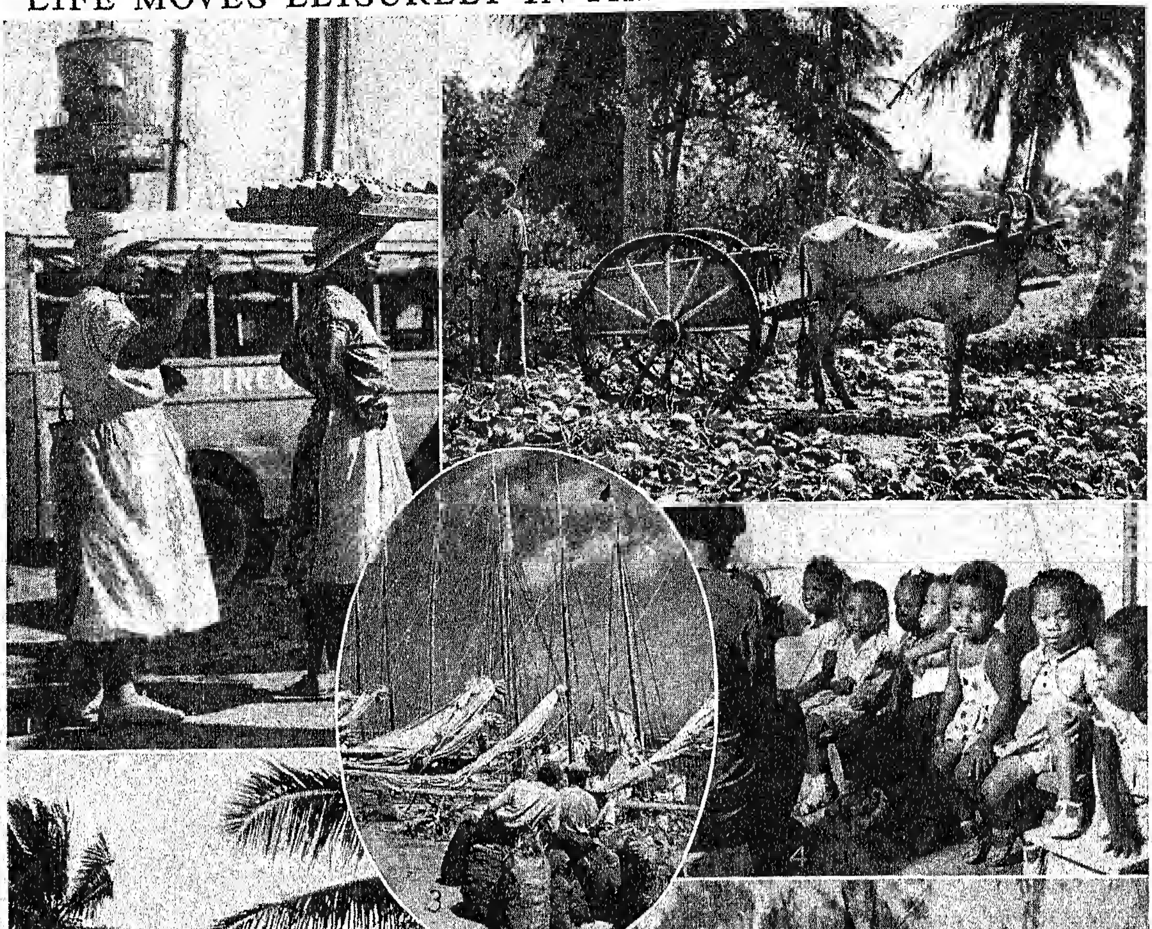


Only six miles from the South American coast, Trinidad (above) is one of the most important outposts of United States defense for the Caribbean area. Here the United States has great army, navy, and air bases on land leased from the British government. Trinidad, long famous for its asphalt lake, is now even more famous for its oil wells. The picture shows the U.S. cruiser *Phoenix* anchored off the west coast. Martinique (below) is one of the two large islands of the West Indies which still fly the French flag. We are looking across the partially rebuilt city of Saint Pierre at the steep barren cone of Mont Pelée. When this volcano erupted in 1902 it wiped out one of the greatest cities in the Caribbean, with the destruction of nearly 40,000 lives.



Especially engraved for Compton's Pictured Encyclopedia

LIFE MOVES LEISURELY IN THESE TROPICAL ISLANDS



1. On the water front in Bridgetown, capital of Barbados, vendors of tea and peanuts carry their wares like this. If you want a drink of maubey tea, brewed from the bark of the maubey tree, the seller will reach up for a glass and fill it from the urn on her head. 2. In Trinidad the oxcart is still the farmer's chief transport vehicle. This laborer is loading copra. 3. Fishing craft and spongers at Nassau, capital of the Bahamas. The people of the Bahamas are so fond of the water that they pay little attention to farming. 4. A nursery school in the Virgin Islands. The young United States citizens in this picture wear clothes made by the Department of Welfare sewing project. 5. Bamboo shacks like these in Jamaica are being replaced by neat little wooden bungalows. These palm-thatched huts are made of dried bamboo strands woven around a framework of stakes. 6. The natives of Martinique, who are a mixed race of Indian, French, and Negro blood, are famous for their fine physique.

can reach Mexico, Central America, the Panama Canal, the Gulf ports of the United States, or the north coast of South America without traversing some passage through the West Indies. Furthermore, the waters west of the islands carry most of the travel and trade of the mainland nations, because of the lack of good land routes. Hence a strong naval and air power can control the entire region (*see* Caribbean Sea). This has helped to make the islands main objectives of diplomacy and war ever since they were discovered.

Spain used the West Indies to support its early monopoly of trade with the gold-producing lands of Mexico and Peru. Great Britain and France contended fiercely with Spain and with each other for footholds here. For three centuries pirates preyed upon ships and even sacked cities (*see* Pirates and Piracy).

Today the United States maintains dominant naval and air strength in the region, to protect its Gulf ports and the Panama Canal (*see* Navy).

Tropical Climate and Trade Winds

All the West Indies have tropical heat, because the northern limit of the tropical zone, the Tropic of Cancer, passes just north of Cuba and across the Bahamas. But they are far enough north to have some change of season, and to be within the belt of the trade winds (*see* Winds). These winds control precipitation in a peculiar way.

They blow from the east or the northeast the year around, and bring moisture from the Atlantic Ocean. As the wind strikes the mountainous side of each island it is forced up, and it drops some of its moisture. Hence the windward side of each island receives heavy precipitation, and these sides tend to have dense, steaming tropical forests or jungles. The leeward sides are drier, getting precipitation only from heavier storms and thundershowers. This dryness is most marked in winter, when thundershowers are rare. Kingston, on the south or lee coast of Jamaica, has only about one inch of rain a month from December to April, and only 29 inches a year. But Mooretown on the northeast or windward side of the island receives 225 inches a year and has no dry season at all. Most early settlements were made on the lee sides, because ships were better sheltered there and because the plant growth was easier to clear.

The importance of these winds may be seen in the fact that the names of two island groups come from the way they blow—from the northeast over the northerly islands, and from the east in the south. Hence the most easterly islands in the south are called the Windwards; they are nearest the source of the wind. The group immediately north is called the Leewards. The "Windward Passage" between Cuba and Hispaniola is so named because, to sail through it from the Caribbean, a ship had to sail into the northeast wind —that is, to windward.

Hurricanes are frequent and destructive. These violent tempests arise over the Atlantic (as is told in the article Storms) and travel westward across the Caribbean, often doing terrific damage. The region has about four of them a year, usually in late summer and early autumn. Of 143 hurricanes in a 35-year period, 124 occurred in August, September, and October.

WHO OWNS THE WEST INDIES

Independent: 73,700 square miles; 8,500,000 population
CUBA HAITI DOMINICAN REPUBLIC

Great Britain: 12,500 square miles; 2,250,000 population
BAHAMAS BARBADOS
JAMAICA (islands, *Jamaica, Turks and Caicos, Caymans*)
LEEWARD ISLANDS—including Antigua (islands, *Antigua, Barbuda, Redonda*); St. Kitts-Nevis (*St. Christopher, Nevis, Anguilla, Sombrero*); Montserrat; and British Virgin Islands
TRINIDAD (islands, *Trinidad, Tobago*)
WINDWARD ISLANDS—including Dominica; Grenada (islands, *Grenada, Carriacou*); St. Lucia; St. Vincent (*St. Vincent, Lesser Grenadines*)

France: 1,100 square miles; 545,000 population
GUADELOUPE (islands, *Marie Galante, Les Saintes, Désirade, St. Barthélemy*, north half of *St. Martin*)
MARTINIQUE

Netherlands: 403 square miles; 100,000 population
CURAÇAO (islands, *Curaçao, Aruba, Bonaire*, south half of *St. Martin, St. Eustatius, St. Saba*)

United States: 3,568 square miles; 1,900,000 population
PUERTO RICO (islands, *Puerto Rico, Culebra, Vieques, Mona, Desecho*)
VIRGIN ISLANDS (islands, *St. Croix, St. John, St. Thomas*)

Venezuela: 550 square miles; 73,000 population
STATE OF NUEVA ESPARTA (islands, *Isla Margarita, Orchilla, Las Aves, La Tortuga, Los Roques*)

Native Plants, Animals, and People

Because of the moist, warm climate, the West Indies are rich in tropical plants of almost every sort. In animal life, they are especially rich in tropical insects, birds, and reptiles; but mammals were rare before the white men came, because they could seldom travel from island to island. Some primitive kinds, such as opossums and raccoons, are common and may have come in when the region was a mountain chain. Others, such as muskrats, could have traveled on driftwood. But the most common wild mammals, pigs and dogs, escaped from white settlements.

The Indians who occupied the region when Columbus found it had come from South America. They belonged to the Carib strain. They were virtually exterminated when they resisted Spanish attempts to enslave them.

White Masters and Negro Slaves

The present population and activities of the region descend almost entirely from those of the early settlements. From the start, the colonists found that the best road to wealth lay through production of tropical crops such as sugar (and rum and molasses from the cane), tobacco, coffee, and cocoa. Unhappily, the monotonous, simple work required for these crops could be performed profitably by slaves, and slavery became the basis of West Indian agriculture from the start. The African Negro proved best able to stand

the work and the climate, and, through three centuries, millions of Negro slaves were imported (*see* Slavery). Only Cuba, Puerto Rico, and the Dominican Republic have any substantial proportion of whites in the population. Elsewhere Negroes and mulattoes outnumber the whites ten or twenty to one. Some islands also have a few Chinese and Hindus, who were brought in to work when slavery was abolished.

Easy Living, Both Yesterday and Today

The older plantation owners concentrated upon growing crops for export, and did not raise food enough even for the slaves. They preferred to buy corn, salt pork, and other coarse food from the North American colonies—a practise that helped in building up these settlements (*see* American Colonies). About the only local food growing was done in little garden patches by escaped slaves and free natives.

To prepare the ground, trees and underbrush were cut with the machete, or burned off. Then plantains and banana trees were planted, and the shrub that yields cassava or manioc (*see* Tapioca). Good ground crops were beans, yams and sweet potatoes, corn, and a kind of rice which does not need flooding. All these plants outgrow the wild ones if given an even start, and so cultivation was not needed. To prepare for a new crop, the cultivator had only to "shave" the ground by sweeping his keen machete along the surface of the soil. This cut off the wild growth, and his crop took care of itself the rest of the year.

The owner's other needs were met almost as simply. To build a house he lashed poles together with palm fiber for the framework, then applied a thatch of palm leaves or the boardlike sheaths from the bottom of the royal palm. If he preferred lumber, he might get it from a wreck, or, in later days, from discarded packing boxes. Today many houses are roofed with gasoline or kerosene tins, beaten into sheets.

Buckets and other utensils could be made from gourds, and palm fiber served to make hammocks, hats, baskets, and ropes. A family could obtain all the clothing it needed by selling a little coffee or fruit, or working for a few weeks on a plantation.

These easy ways still persist, and it is difficult to change them. The hot climate makes strenuous effort difficult. Attempts to introduce northern food crops usually fail, because either weeds choke out the crop or insects devour the seeds and plants.

Modern Problems in the West Indies

Although slavery was abolished during the 19th century, and some peoples won independence, the general standard of living remains at a low level.

The money needed for better livelihoods and other improvements is hard to find, because opportunities are limited. Aside from petroleum on Trinidad, the islands have neither fuel nor water power for manufacturing. And they have no raw materials to manufacture except tropical woods and fibers, and a little iron ore in Cuba. Another bar to the development of manufactures is the monotonous climate, which does not stimulate people to activity.

These conditions compel the islands to depend upon exporting tropical foodstuffs, and this ties their fortunes to market conditions elsewhere. Depression or war in Europe or North America can all but ruin them. Even when markets are favorable, much of the profit from the crops is drained off to foreign owners of land, of processing plants, and of the ships which move the crops. The islands also must pay heavily for those necessities that have to be imported. Finally, dependence upon exporting foodstuffs favors large plantations, and gives little chance to small owners. Some efforts are being made to remedy these conditions, such as the encouragement of embroidery work and cigar making in Puerto Rico, of coffee growing on Haiti's small hilltop plantations, and of fruit growing on small plantations nearly everywhere.

Government Problems and Social Improvement

Problems of government have proved equally difficult. Three nations, Cuba, Haiti, and Santo Domingo, have won their independence and adopted republican government. But in each of these new countries most of the population was densely ignorant, poverty-ridden, and filled with hate of rulers as oppressors. Under such conditions democratic government could only develop slowly, and the history of these nations has been marked by revolutions and dictatorships. Their best hope for the future lies in educating the people, improving their incomes, and raising the standard of living until they feel they have something to lose through bad government.

The rest of the islands (except the few that belong to Venezuela) have remained European colonies or have passed to the control of the United States. These islands have avoided revolutions and dictatorships; but economic improvement and provision of schools, roads, and other services have been difficult. In Puerto Rico and the Virgin Islands, government and individual income have been better than elsewhere, because these islands could sell their products in the United States without paying high duties. But even here taxes cannot produce all the revenue needed, and Congress has had to appropriate money constantly for aids and improvements.

Of the European ruling nations, only Great Britain has shown both willingness and ability to finance efforts for large-scale improvements. In 1938 the British government named a royal commission, to recommend helpful measures for the British West Indies. This commission framed a program to be financed by a grant of £1,400,000 a year for providing schools, roads, medical attention, housing, and aid to small industries. But not much could be done, when Britain became involved in war in 1939. (*See also* articles on the separate countries, colonies, and important islands, and the entry **West Indies** in the FACT-INDEX at the end of this volume.)

WEST'MINSTER ABBEY. To walk about the aisles and chapels of England's most famous church is to call the roll of history. Everywhere one turns his eyes he sees memorials to famous names.

As burial here is one of the great honors England bestows upon her sovereigns and greatest sons, many indeed are the mighty dead who slumber in this old Gothic church by the Thames. Close around the shrine of Edward the Confessor are sepulchers of various kings and queens. And in Henry VII's elaborate chapel, "the most gorgeous of mausoleums," along whose sides are the lofty richly carved stalls of the Knights of the Bath, stand the sepulchers of its founder, of haughty Queen Elizabeth, of the lovely unfortunate Mary Queen of Scots, and of many another famous member of royalty and nobility.

Courtiers, statesmen, soldiers, theologians, actors, artists, scientists, and musicians—all may be found in this "mansion of shadowy honors." And in the south transept, near the resting place of many famous men of letters, is the Poet's Corner, whose gray walls are lined with tablets, busts, and monuments of England's well-loved poets. Here is the marble tomb of genial Chaucer, the father of English poetry, over which is a memorial window with a picture of the Canterbury Pilgrims. Near the bust of Shakespeare's fellow-poet, "rare Ben Jonson," lies "the gentle Spenser, Fancy's pleasing son." Although he died in misery yet he had a brave funeral, and many men of genius of his day threw their poems to be buried with him. And not far from the burial places of Tennyson and Browning is the bust of Longfellow, placed there in 1884 by "the English admirers of an American poet." Gay's monument with its mocking epitaph, inscribed there by his own request—

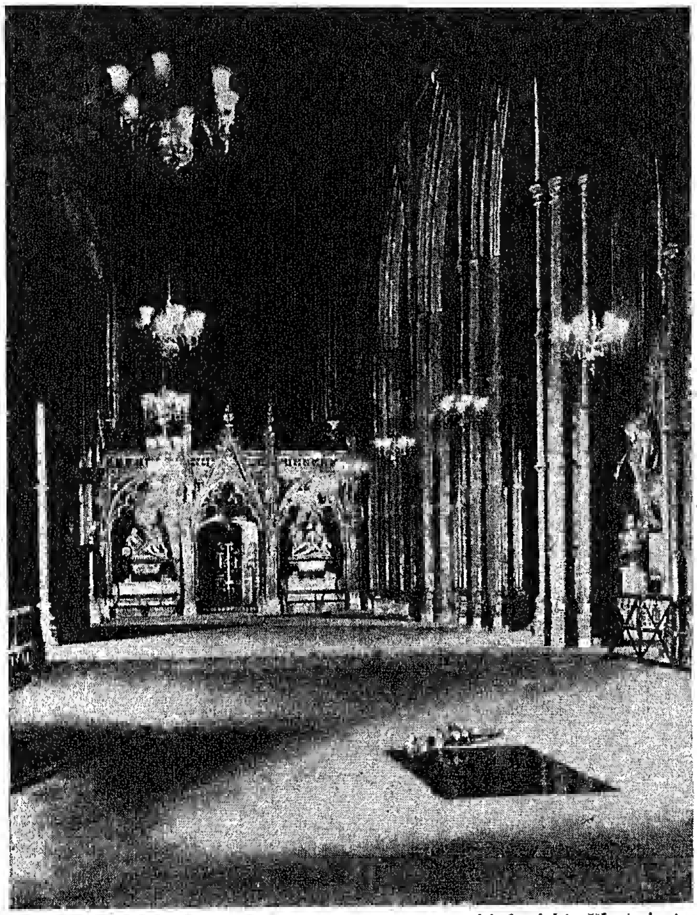
Life is a jest, and all things show it,
I thought so once, but now I know it—

strikes a different note from the epitaphs of the many other poets represented here; particularly from the beautiful lines carved upon the scroll carried by the statue of immortal Shakespeare, who from his niche looks serenely down upon his fellow poets:

The cloud-capped towers, the gorgeous palaces,
The solemn temples, the great globe itself,
Yea, all which it inherit, shall dissolve
And, like this insubstantial pageant faded,
Leave not a rack behind.

The venerable Abbey has witnessed many a brilliant coronation scene; since William the Conqueror every sovereign, except Edward V and Edward VIII, has here been crowned. In the Chapel of Edward the Confessor still stands the coronation chair containing beneath its seat the ancient Stone of Scone brought from Scotland, which tradition says was the stone that Jacob used for a pillow.

WHERE SLUMBER THE MIGHTY DEAD

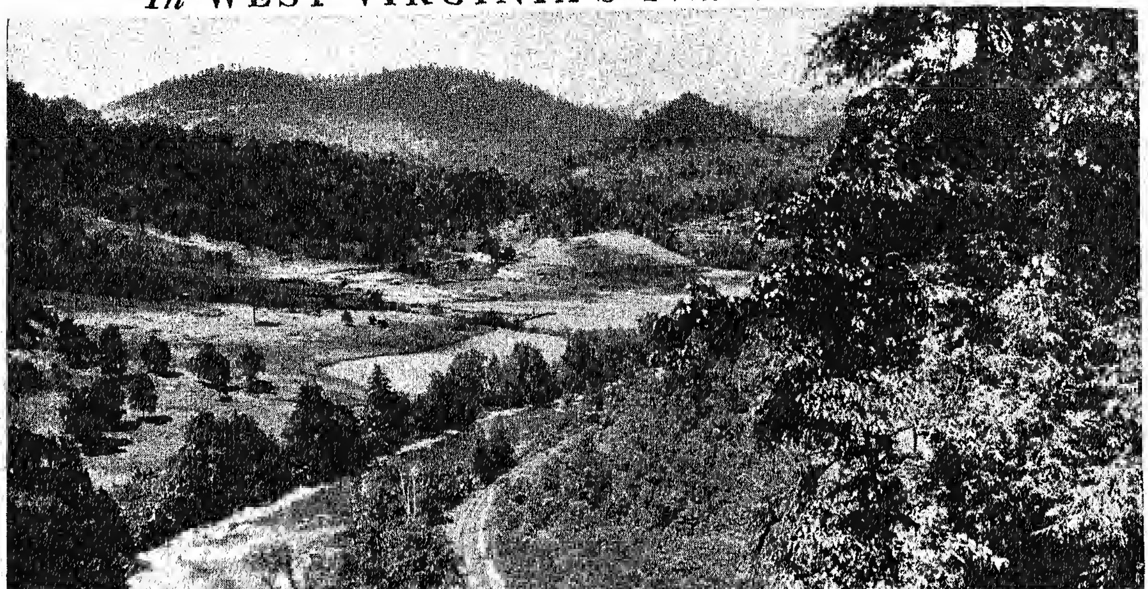


The highest honor England gives to her illustrious dead is burial in Westminster Abbey. Simplest, yet most revered of all the tombs in this Valhalia of British heroes is the grave of the Unknown Warrior, which we see in the center of the nave above. The grave was filled with French soil, and the slab is of black Belgian marble. The great nave, which was under construction for two centuries and completed about 1500, has a magnificent soaring appearance from the great height of its columns, 102 feet, compared with its narrow width of 38 feet.

Westminster Abbey was originally the church of an old Benedictine abbey built in the 7th century. The foundation became important when in 1049–65 Edward the Confessor built a church on the present site, dedicating it to St. Peter. This was reconstructed in the 13th century, and later there were made numerous additions (including Henry VII's chapel of the 16th century and the two west towers by Sir Christopher Wren and Hawksmoor of the 18th century). The Abbey, whose official name is the Collegiate Church of St. Peter, is 423 feet long. The towers rise 225 feet.

Some of the other famous men represented in the Abbey are Milton, Coleridge, Burns, Macaulay, Dickens, Darwin, Newton, and Disraeli. Two Americans, James Russell Lowell and Walter Hines Page, are honored by memorials in the Chapter House of the Abbey.

In WEST VIRGINIA'S *Timbered* HILLS



A Picturesque Glimpse of the Elk River in West Virginia's Monongahela National Forest

WEST VIRGINIA. In natural beauty and resources the "Mountain" or "Panhandle" state has few rivals. Coal and chemicals are a basis on which West Virginia has built industrial wealth. More bituminous coal is mined here than in any other state in the nation. This abundance of coal coupled with large salt deposits has brought the state a vast chemical industry.

Extent.—East to west, [illegible] miles; north to south, [illegible] miles. Area, 24,181 square miles. Population (1940 census), 1,901,974.
Natural Features.—Allegheny Mountains (Spruce Knob, 4,860 feet) extending from northeast toward southwest in parallel ranges; Cumberland Plateau, broad rolling hills sloping to Ohio Valley, which forms the northwestern boundary. Principal rivers: Potomac and its South Branch; Ohio and its tributaries, Monongahela, Little Kanawha, Kanawha, Guyandot, and Big Sandy. Mean annual temperature, 53°; mean annual precipitation, 43".
Products.—Hay, corn, potatoes, oats, tobacco; poultry and eggs, cattle and milk, hogs, sheep and wool; coal, natural gas, clay products, petroleum; iron and steel, glass, lumber and timber products, coke, chemicals, petroleum refining.
Cities.—Huntington (78,836), Charleston (capital, 67,914), Wheeling (61,099), Clarksburg (30,579).

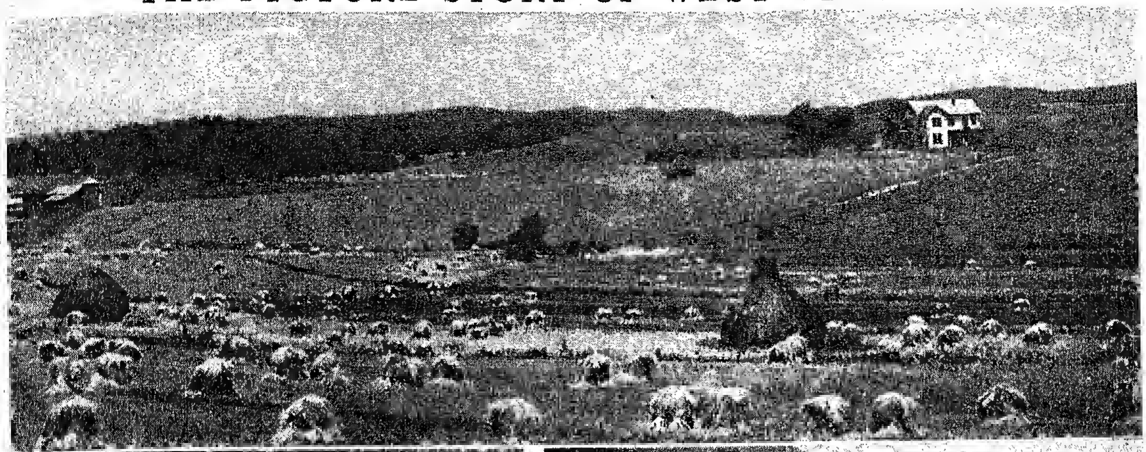
West Virginia's 24,181 square miles form a unique part of the nation. The state is not quite a central state nor an eastern state, and although most of it is south of Mason and Dixon's line, it has never been counted a southern state. Its boundaries are determined chiefly by rivers and mountain ridges. The Alleghenies separate it from Virginia, the Potomac River from Maryland, the Big Sandy from Kentucky, and the Ohio River from the state of Ohio. The northeastern part of the state splits in two around the square corner of Pennsylvania.

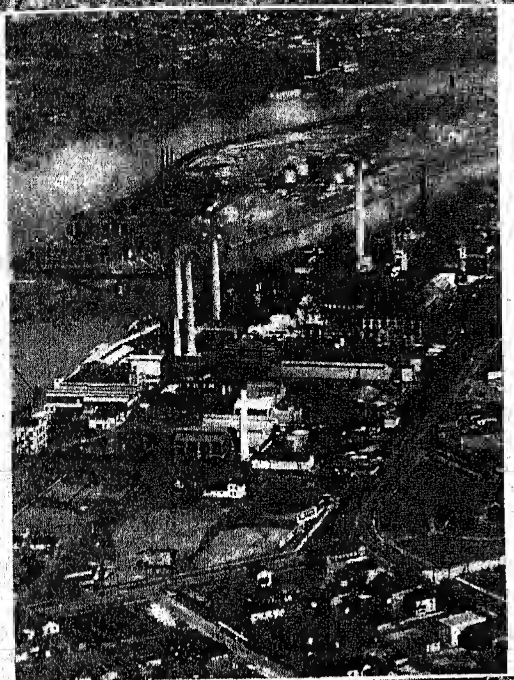
West Virginia has the highest average elevation (1,500 feet) of any state east of the Mississippi River. But this average figure is deceptive. The surface of the land rises and falls through a great range of altitudes from Harpers Ferry, 240 feet above sea level, to Spruce Knob, 4,860 feet high. This gives the state a climate and plant life as varied from place to place as if part of it were in southern Canada, part in New England, and part in Virginia; and the natural ruggedness of terrain results in scenery of great beauty and diversity.

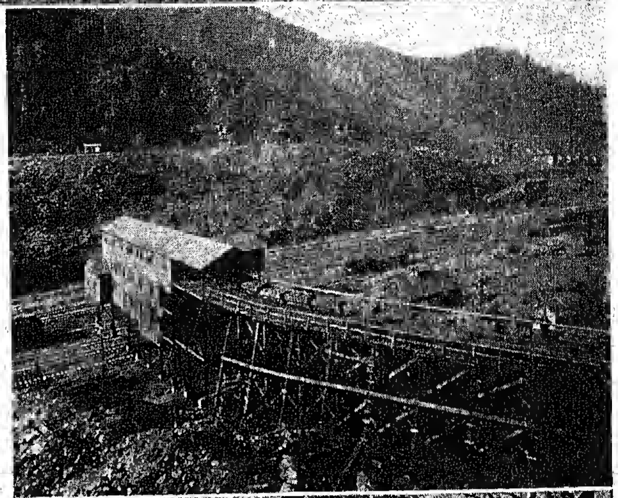
Most of the state slopes to the westward, and the Kanawha, Little Kanawha, Guyandot, and Big Sandy rivers drain into the Ohio River. In north central West Virginia, the Tygart and West Fork rivers join to form the Monongahela. A great dam on the Tygart River regulates flood waters and permits year-round navigation on the Monongahela. The extreme northeastern section drains toward the east through the Potomac River and its branches. Here on the Maryland boundary, where the Potomac and Shenandoah rivers join and carve a gap through the Blue Ridge Mountains, is Harpers Ferry, scene of John Brown's historic raid (*see* Brown, John).

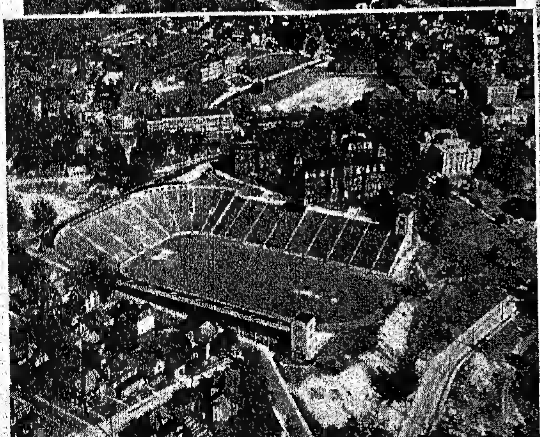
Numerous mineral springs in the eastern part of the state have attracted visitors since the days of George Washington. Berkeley and Capon Springs are owned by the state through a bequest of the wealthy landowner of Colonial days, Lord Thomas Fairfax, for whom Washington worked as a surveyor. Red Sulphur and White Sulphur Springs were watering places before West Virginia became a state.

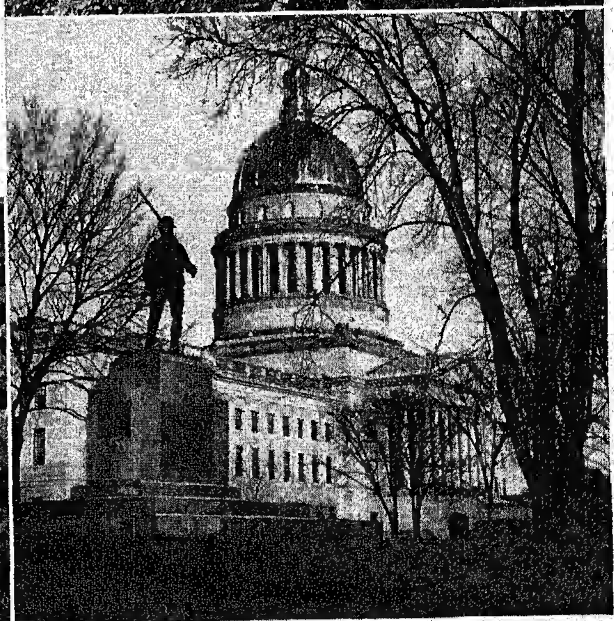
Travel over the steep eastern mountain slopes in pioneer days was difficult. The only method of transportation was by pack animals. In local speech even today what a northerner "carries" and a southerner "totes," a West Virginia mountaineer "packs." Each pioneer clearing was economically self-sufficient. Practically all food was home-grown; most of the articles used were homemade—wooden bowls and plates for the table, wooden plows and other implements for





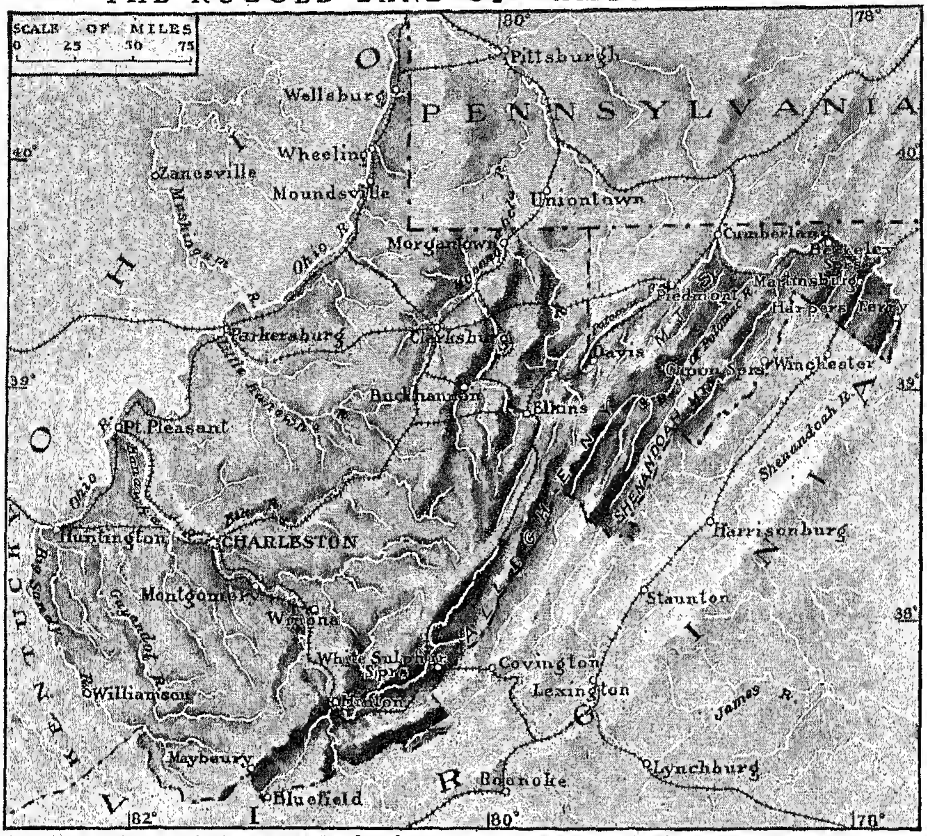




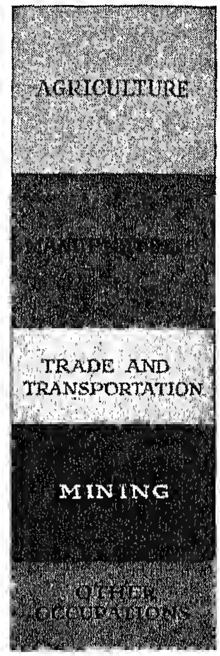


Rolling wheat fields with blue hills in the distance (top) are typical of the fertile valleys in the eastern Allegheny region. The air view of Charleston's industrial section (left center) shows one of the city's great chemical plants. Coal mines (right center) are found in 49 of the state's 55 counties. The view of the state university at Morgantown (lower left), by Fairchild Aerial Surveys, Inc., shows Mountaineer Field, the stadium, in the foreground. The university held its first classes in 1867. The State Capitol (lower right), designed by Cass Gilbert, was completed in 1932.

THE RUGGED LAND OF "AMERICA'S SWITZERLAND"

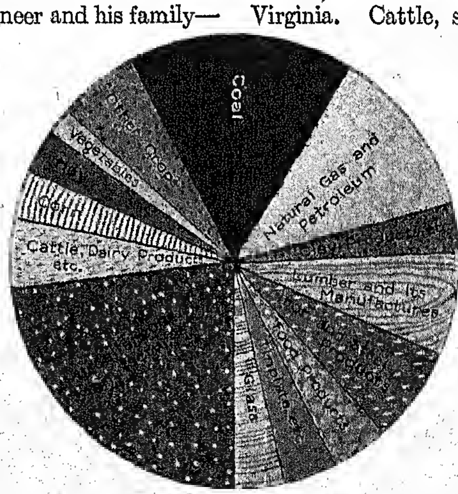


The map shows clearly how West Virginia is a land of tumbled mountains and twisting rivers, with the Alleghony ridge as backbone. The chart below compares the leading occupations of the people.



the farm. When it became absolutely necessary to have things that could not be obtained from the fields or the woods or made by the pioneer and his family—or things like salt, iron tools or other manufactured articles—a neighborhood would load a caravan of pack-horses with peltries, ginseng, and bear's grease and send it down to trade at the nearest market.

This difficulty of transportation naturally delayed the development of agriculture and other resources of the state. The steam thresher and other improved farm machinery did not come into use until 1880. To be sure, more than half the state is over 1,500 feet in altitude (a large area over 2,000 feet) and hence less adapted to crops than to stock-raising and lumbering. The western (lower) part grows corn, buckwheat, rye, oats, tobacco, and sugar-cane (for molasses, not sugar); the eastern (higher) part produces more live stock. West Virginia is especially adapted to raising hardy horses. In some eastern markets, it is said, the best recommendation a horse can have, next to being a good animal, is to have been born and bred in West Virginia. Cattle, sheep, and hogs are also raised.



This graph shows the relative value of West Virginia's products. Notice the great importance of minerals.

Here, as in New England, the hillsides have been found well suited to orchards. Grimes' Golden apple originated in West Virginia, which is also an important peach-growing state.

But West Virginia's most important resources, ranking ahead of farm products, are coal, petroleum, and natural gas. Coal underlies nearly two-thirds of the state. Some of the coal lies 1,300 feet deep, to be sure, but nearly all English coal is raised from a depth of 1,000 to 3,000 feet. West Virginia coal is remarkably free from sulphur and other impurities, and the beds include many varieties—anthracite, bituminous, and one of the largest known areas of pure cannel. The state's great range of altitude is most advantageous in coal-mining, for it drains the mines of water and gas and permits coal to be hauled from the mines by gravity.

The social conditions of the coal-mining region are just the opposite of those of the agricultural part of the state. The farming population is almost all white and the great majority is native born. Most farmers own their farms. West Virginia keeps the key to her granaries, but the key to the coal-bins in the cellar is in other hands. Much of the coal land is owned outside the state, and an increasingly large number of foreigners have been drawn in as miners. Most of the coal is used in other states.

West Virginia was long a leader among the states in the production of natural gas, and crude petroleum is also an important product. The production of oil and gas in the whole Appalachian field, however, has been displaced from national leadership by the rise of the Oklahoma, Kansas, California, and Texas fields. Most West Virginia oil is piped to Philadelphia and Baltimore, and most of the gas to the cities of the state and to Cleveland and Pittsburgh. Among other mineral products are fire clay and potter's clay, salt (drawn from brine wells), glass sand, grindstone, black slate, limestone for cement and fertilizers, and a large variety of building stones. Iron ores are found but are not largely worked at the present time.

Forests cover more than half the area of the state. It is an important producer of hardwoods, principally oak, yellow poplar, and maple. Large quantities of hemlock are also cut. The beautiful state and national forests in the mountains provide refuge for native game birds and wild animals, and recreation for camper, hiker, and fisherman.

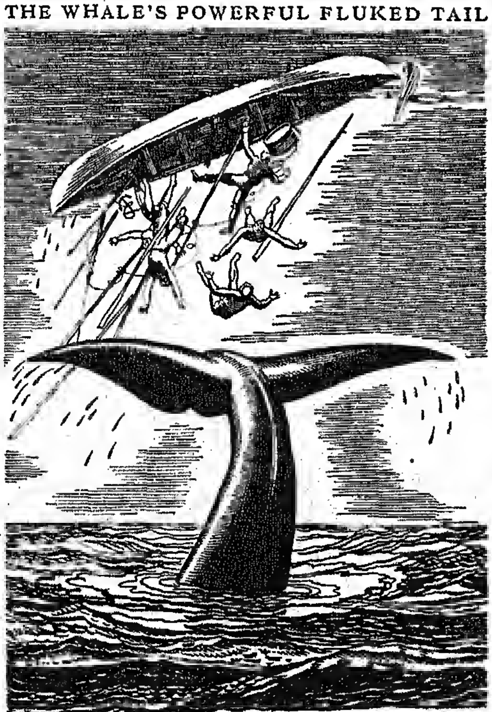
The Kanawha and Ohio valleys are among the world's greatest chemical manufacturing regions. They produce plastics, rayon, pigments and paints, fertilizers, dyes, and a great variety of other chemical products. Glass and glassware rank second in value. West Virginia is one of the three leading glass manufacturing states. Pottery and porcelain ware, lumber products, refined petroleum, and stamped and pressed metal products are also important. Morgantown is the seat of the state university.

West Virginia was formed by secession from a seceding state. When Virginia joined the Confederacy, the western part, separated by the mountains and more closely connected with Ohio and Pennsylvania, refused to follow. Conventions were held and a separate state formed as West Virginia, which was admitted into the Union in 1863.

The HUGEST *of* GIANTS *Living or Dead*

WHALE. Though we speak of "whale-fishing," these animals are not fish at all, but true warm-blooded mammals. That their very ancient ancestors were land animals we know from their skeleton and other parts; it is especially evident in the very young ones, which are born alive and are fed with mother's milk, like land mammals. Under the zoölogical name *Cetacea,* or cetaceans, are grouped not only the huge true whales but their smaller relatives the dolphins, about which were woven so many ancient fables; the sportive porpoises, familiar to all who sail the seas; the blackfish, hunted for its oil; the white whale or beluga, which is often seen in the lower St. Lawrence River; the savage grampus called the "killer"; and the queer narwhal, one of whose front teeth grows out into a twisted spearlike tusk stretching straight in front of its snout to the length of four or five feet.

THE WHALE'S POWERFUL FLUKED TAIL

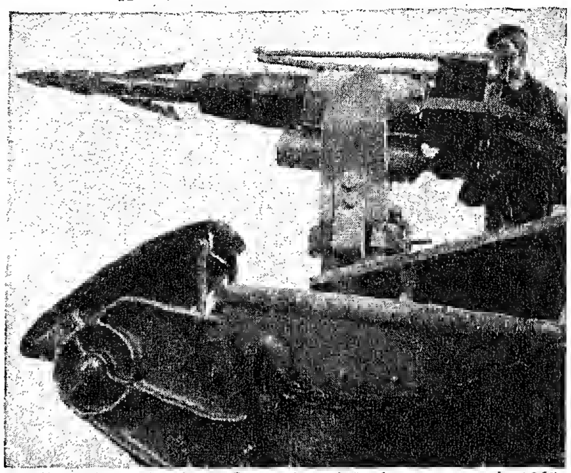


Here is one of Rockwell Kent's pictures of a tense, dramatic moment in the story of the "great white whale", drawn for a modern edition of Herman Melville's 'Moby Dick' (Random House).

In all these animals the shape has become fishlike in accordance with the fishlike manner of life. The skin is smooth, with a few traces of hairs, and usually black, or black and white, or sometimes all white. The hind limbs have disappeared, a powerful flat tail doing their work in swimming; and the fore limbs have become paddles. These have the same bones as in our arms, but much shortened; while the fingers are greatly lengthened and inclosed in a mitten of flesh making the "flippers." As whales have lungs (not gills) and breathe air, they must come to the surface every half-hour or so for that purpose. At the instant they emerge the pent-up air is expelled from the lungs through the nostrils at the top of the nose. In the case of the larger species this big discharge of moist breath condenses in the cold air into a visible vapor, often mixed with sea-spray, which is called a "blowing"; but no water is expelled from the mouth. The nostrils are connected directly with the windpipe, so that whales can swim with their mouths open without strangling. Smaller kinds

of cetaceans, of which the variety is immense, are in the main fish-eaters; but the killer seizes and devours porpoises and seals also, and a band of killers may unite to worry a big cachalot (sperm whale) to death. Most whales go about in small bands, or "schools."

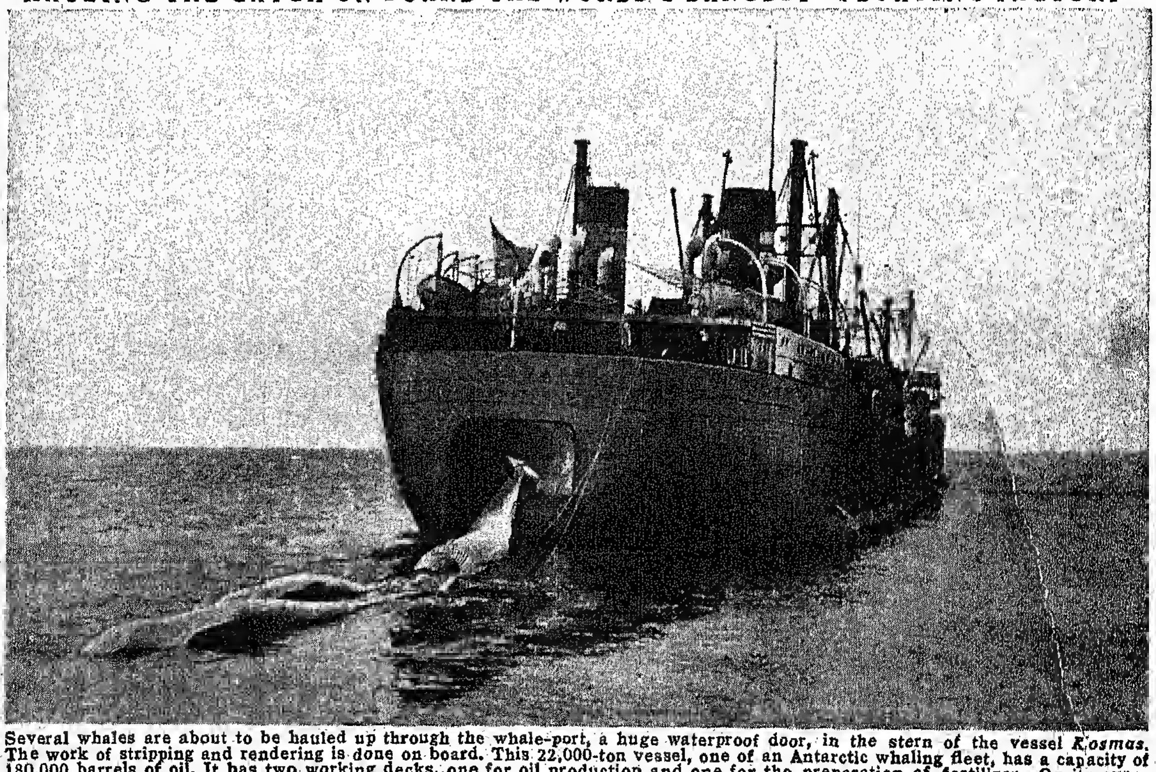
THE DEADLY HARPOON GUN



Until the invention by a Norwegian of the harpoon gun, in 1865, the largest and speediest whales often escaped the fishermen. But the new device, which you see here, made whaling far more deadly for the whales and correspondingly safer for the whalers. The great dart with cable attached is fired from the gun, and after it penetrates the whale a powder charge contained in the cap at the tip explodes, usually causing instant death.

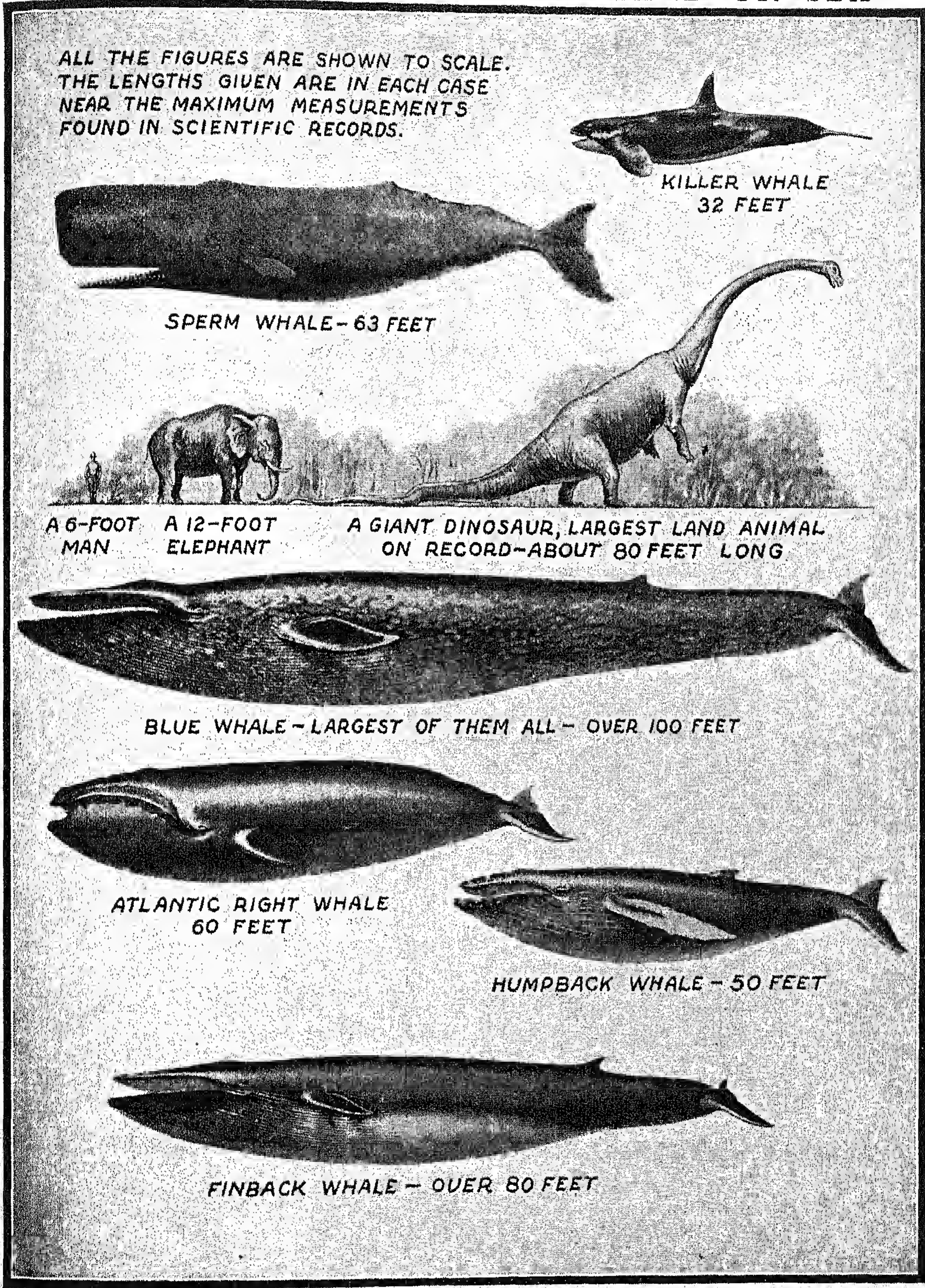
The "great" whales are divided into two sub-orders: (1) baleen whales, and (2) toothed whales. In the first group are the three species of right whales, formerly hunted to the verge of extinction for the flexible baleen or whalebone which hangs from the roof of their mouths in a dense fringe of 300 or more blade-shaped plates, 8 or 10 feet long. Right whales are huge creatures, often 50 to 75 feet long; they range through all oceans, even amid Arctic ice, and occasionally cross from one side to the other of the North Polar Sea. Nevertheless, despite their enormous bulk and power, these whales subsist altogether on the shrimplike crustaceans and other minute creatures that crowd the surface of the ocean, especially in cold latitudes. These are swept into the whale's mouth by the million as it rushes along, the water flowing out of the sides of the mouth, and the food being caught by the fringes of the baleen and sucked down like a continuous meal of soup. In addition to whalebone obtained from these whales, the hunters cut away and save the thick layer of fat (blubber) underlying the skin and surrounding the body in a warm blanket, from which oil is extracted. Today flexible steel has taken the place of whalebone, but the oil is still valued for glycerine, soaps, and creams. Other baleen whales are the rorquals and the humpback, now the most hunted species, and the small pigmy whale of New Zealand waters, only 20 feet long.

HAULING THE CATCH ON BOARD THE WORLD'S LARGEST "FLOATING FACTORY"



Several whales are about to be hauled up through the whale-port, a huge waterproof door, in the stern of the vessel *Kosmos*. The work of stripping and rendering is done on board. This 22,000-ton vessel, one of an Antarctic whaling fleet, has a capacity of 180,000 barrels of oil. It has two working decks, one for oil production and one for the preparation of fertilizer. On its expeditions it is accompanied by seven steam hunting-boats and an airplane.

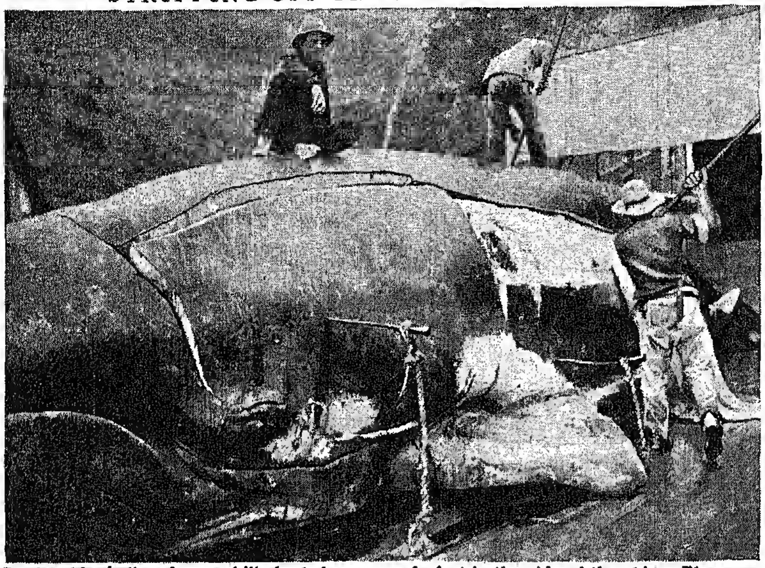
THE HUGEST MONSTERS OF LAND OR SEA



Even if some of the dinosaurs, as certain scientists claim, may have exceeded 100 feet in length, most of this measure would have been in neck and tail. The bulk of the animals could not be compared to that of the mammoth whales, some of which have young that are as large on the day of their birth as a full-grown elephant.

The principal rorquals are the blue whale, the finback, and the sei whale. The blue rorqual, or "sulphurbottom," giant of them all, is probably the largest animal that ever lived. Whalers have reported colossal specimens over 100 feet long. A weight of 75 tons is only average. New-born blue whales are far larger than full-grown elephants. They measure some 25 feet in length, weigh about 8 tons, grow very rapidly, and reach a length of about 60 feet during the first year while still nursing.

STRIPPING OFF THE BLUBBER BLANKET



In the old whaling days, a killed whale was made fast to the side of the ship. The crew in spiked boots jumped down on the carcass, stripped off the skin, and dug out the blubber with spades. On board, the oil was cooked out of the blubber and stored in casks. The rest was waste. Nowadays, the carcase is towed to a shore whaling station, like this one in New Zealand, or to a factory ship. After the oil is extracted, the meat is canned, and the remains are made into fertilizer and chicken feed.

The toothed whales comprise the sperm whale or cachalot, its lesser cousin the cogia, the small "beaked" whales, the white whale, the narwhal, and the dolphins. A valuable member of the dolphin family is the pilot whale or blackfish, its head yielding a fine oil used for watch lubrication.

The sperm whale, that monster so vividly described in Melville's 'Moby Dick', reaches a length of 60 feet or more, and is distinguished by its immense flat-topped, almost square-fronted head which makes up one-third of its total length. The thin lower jaw, somewhat shorter than the snout, is armed with strong pointed ivory-like teeth eight or ten inches long. These whales dive to a great depth to hunt the squid and cuttlefish that form their chief food, although fishes are also eaten at times. The teeth are not adapted for mastication, but can cut up large prey into manageable pieces. Many whaling boats attacked by maddened sperm whales have been crushed to matchwood in their massive jaws. The cachalot is probably the only creature that dares attack the giant squid, which, with its outstretched arms, measures as great a length as itself; and the marks inflicted by the squid's cruel suckers are often seen on the hides of captured whales. The value of the sperm whale lies chiefly in the many barrels of liquid fat that fill a vast cavity in the top of the head, from which spermaceti and a fine oil are extracted. Spermaceti, once used for candles, now goes into face creams and medicines. Ambergris, a waxy concretion formed in the intestines of diseased sperm whales, and often found floating on the sea, is important in perfumery. More than 150 pounds of ambergris have been taken from a single whale, and sold for $100 an ounce.

A whaling trip was a dangerous adventure when New England whalers stocked their tall-masted sailing vessels for a voyage of three to five years. High in the rigging a lookout spied the vapor rising as a massive head came up for air. "There she blows!" he shouted. Then the crew manned sharp-pointed boats and rowed furiously toward the churning water. Close to a mammoth body, the steersman gave the signal and the harpooner dropped his oar and flung the barbed harpoon with its fathoms of strong rope. The maddened whale plunged through the water, a wake of blood and foam behind him, pulling the 25-foot boat along like a plaything. Next he "sounded," or dived to the depths, as the taut line slipped from its coil. When he came up for air, a right whale might overturn the boat with his tail flukes, or a sperm whale might crush it with his powerful jaws. But soon the lances of the headsman found a vital spot in the huge bulk. A last shudder, and the dead prey was ready to be hauled back to the boat, its blubber stripped off and tried out (cooked) for its precious oil.

How the "Floating Factory" Works

Today, great, efficient factory ships head a small fleet of swift motor or steam vessels, manned by rugged Norwegians. The factory finds a berth in a snug Antarctic harbor. A look-out airplane sails high over icy waters to sight the glittering backs and flying spray. Their position is radioed to the hunting vessels, which race toward the prey. The harpoon flashes from the Svend Foyn gun, its bomb exploding in the blubber. A steam winch runs off the cable and hauls in the carcass. Pumped full of air to keep it afloat, it is towed to the floating factory, where a great slip yawns to receive it. Powerful steam digestors wring every drop of oil from blubber, flesh, and bone. Chicken feed and fertilizer are made from the scraps. So efficient are these modern methods that these greatest of all mammals are in danger of extermination. (*See* Dolphin; Porpoise.)

The GOLDEN GRAINS *that Give Us* OUR DAILY BREAD

WHEAT. "Give us this day our daily bread." Throughout the world the old prayer rises. And throughout the world comes an answer from the golden wheat fields. From the prairies of Saskatchewan to the pampas of the Argentine, from the Volga to the Nile, from the plains of India to far-away Australia, pours a flood of wheat to feed a hungry world.

The white races prize wheat above all other grains. There are many reasons for this. First, it makes bread of especially fine quality. We may tire of rice or corn, but the flavor of wheat bread never palls. And wheat bread is light and fluffy, because its food protein, *gluten,* holds in bubbles of gas when the dough rises.

Again, wheat is the best of all grains for handling and storage. The compact little wheat berry packs well and has high food value. Five bushels of wheat make more than a barrel of flour, so stored wheat is concentrated food. Wheat keeps so well that it can be stored for years, or shipped around the world.

Being a plant of the grass family, wheat will grow under either scanty or abundant rainfall, wherever the spring is cool and moist and the summer is hot and dry. The best soils are deep, well-drained loams and clays. Even the border of the Arctic Circle and the plateaus of Mexico, Chile, Tibet, and Ethiopia have wheat fields. Finally, wheat grows closely enough on its tall thin stems to keep weeds choked out; so no cultivation is needed after sowing.

FOLLOWING THE WHEAT CROP AROUND THE WORLD

Wheat is being harvested somewhere all the time. This table shows when the crops are gathered.

January: Chile, New Zealand, Australia, Argentina.
February and March: Upper Egypt, India.
April: Lower Egypt, India, Persia, Asia Minor, Cuba, Mexico, Syria, Cyprus.
May: Texas, Algeria, Morocco, China, Japan, central Asia.
June: California, Utah, Oklahoma, Kansas, Arkansas, Missouri, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia, Kentucky, Tennessee, Spain, Portugal, southern France, Italy, Greece, Turkey.
July: Washington, Oregon, Wyoming, Nebraska, Iowa, southern Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York, New England, southern England, Germany, southern Russia.
August: Montana, the Dakotas, central and northern Minnesota, Canada, northern England, Belgium, the Netherlands, central Russia.
September and October: Parts of western Canada, Scotland, Scandinavia, northern Russia.
November: South Africa, Peru, northern Argentina.
December: New South Wales, Burma, Argentina.

Many Kinds of Wheat

A wheat farmer's first task is to choose a variety of wheat suited to his climate, soil, and market. Wherever the winters are mild enough, farmers plant *winter wheat* in the autumn. It germinates and takes root, then lies dormant until spring, and is ready for the harvest in early summer. Winter wheat is grown from Texas, Oklahoma, and Kansas through the North Central and Middle Atlantic states. It usually furnishes nearly two-thirds of the American wheat crop. Minnesota, the Dakotas, the Pacific Northwest, and Canada grow *spring wheat,* and harvest it in late summer. (For maps, *see* United States.)

When rainfall exceeds 30 inches a year, wheat tends to be rich in starch and low in gluten. Such *soft wheat* lacks stickiness for breadmaking, but is fine for pastries and for mixing with bread wheats. It grows best east of the Missouri River and in the Pacific Northwest. *Hard wheat,* grown in the drier Great Plains states and in western Canada, is rich in gluten and makes fine bread flour. *Durum wheat* is extremely hard; it is used for semolina, macaroni, and spaghetti. It is grown in and near the Dakotas. There are winter and spring varieties of both hard and soft wheat. Soft spring wheat is usually called *white wheat.* Soft wheats form from about a quarter to more than a third of American production, and are a reliable crop, since they enjoy assured rainfall.

How Wheat Is Grown

Methods of growing and harvesting wheat changed scarcely at all from ancient times until the 19th century. Seed was broadcast by hand, and harvested with a sickle. One improvement was the *cradle,* a scythe with a framework that catches the stalks as they are cut. Flails or the trampling feet of oxen threshed the grain from the straw. Such methods require three to four hours of human labor for every bushel of wheat produced. Machinery does the work today in the great wheat regions. Tractor-drawn gang-plows, followed by steel-toothed harrows, prepare the ground, and drill seeders plant the seed.

Until the grains are large, they are plump and soft and contain a milky fluid. Then they become solid, and the change from green to a golden-yellow color tells that the wheat is ripe.

Harvest is a busy time, because there can be no delay. If the wheat is cut too soon, it will not keep well; if it is cut too ripe, much of the grain is scattered and lost. In older days a vagabond army of 100,000 or more harvest hands "followed the crop" as it ripened, from Texas in early summer to northern Canada in October. They manned the reapers or headers that cut the grain, and the threshers that separate the wheat from the chaff and straw. Now "combines"—machines which cut and thresh at the same time—have greatly reduced the number of men needed and speeded harvesting (*see* Reaping Machines; Threshing). With combines a crew of four men can gather the yield from 75 acres of wheat in a day.

How Science Aids the Wheat Farmer

The Departments of Agriculture in both the United States and Canada have worked constantly to discover and develop the best wheats for different regions. Soft wheats have always done well in the eastern United States and the Pacific region. The great task, therefore, has been to provide hard wheats suitable for the Great Plains. Roller grinding also had to be introduced, since grinding by millstones is not

suited to hard wheat (*see* Flour and Flour Milling).

Farmers noticed that the Russian Mennonite settlers in Kansas usually got crops, regardless of conditions, from red winter wheat they had brought with them from the Crimea. Today this Turkey wheat is the most widely sown variety in the United States. From it the Kansas Agricultural Station has developed Kanred wheat by *pure-line selection*, or continual planting of the best wheat from one strain.

In 1904 the Kubanka durum wheat brought from Russia by Mark A. Carleton proved able to resist drought and black stem rust in Dakota. Growth of durum wheat is limited, however, by its relatively small market for "wheat paste" specialties.

The Story of Marquis Wheat

The greatest success of the scientists was in developing a hard spring wheat that would ripen before frost came, even when planted late. William Saunders, in charge of the Dominion Experimental Farms of Canada, started to develop such a wheat in 1892. He had his son, Arthur Percy Saunders, and Thomas Sharpe, one of his superintendents at Agassiz, B. C., cross the high-yielding Red Fife wheat then used with an early-ripening wheat called Red Calcutta. They did this by *hybridizing*, or placing pollen from the Fife on the Calcutta pistils.

In 1903–04, William Saunders' son Charles selected from the resulting hybrid a strain which he called "Marquis." In 1907 at Indian Head, Saskatchewan, this Marquis wheat made a crop when early frost after a late planting had ruined every other variety. The new wheat sprang into instant popularity; today it yields three-fourths of the North American hard spring wheat crop. Marquis wheat was a great factor in making Canada the leading wheat exporting country of the world. Charles Saunders was knighted and given a pension for his share in the achievement.

The main problem of research today is to develop wheats which can resist insect and fungus pests. Chief among these are rusts and smuts, the chinch bug, the Hessian fly, and grasshoppers (*see* Chinch Bug; Grasshoppers; Hessian Fly; Rusts and Smuts).

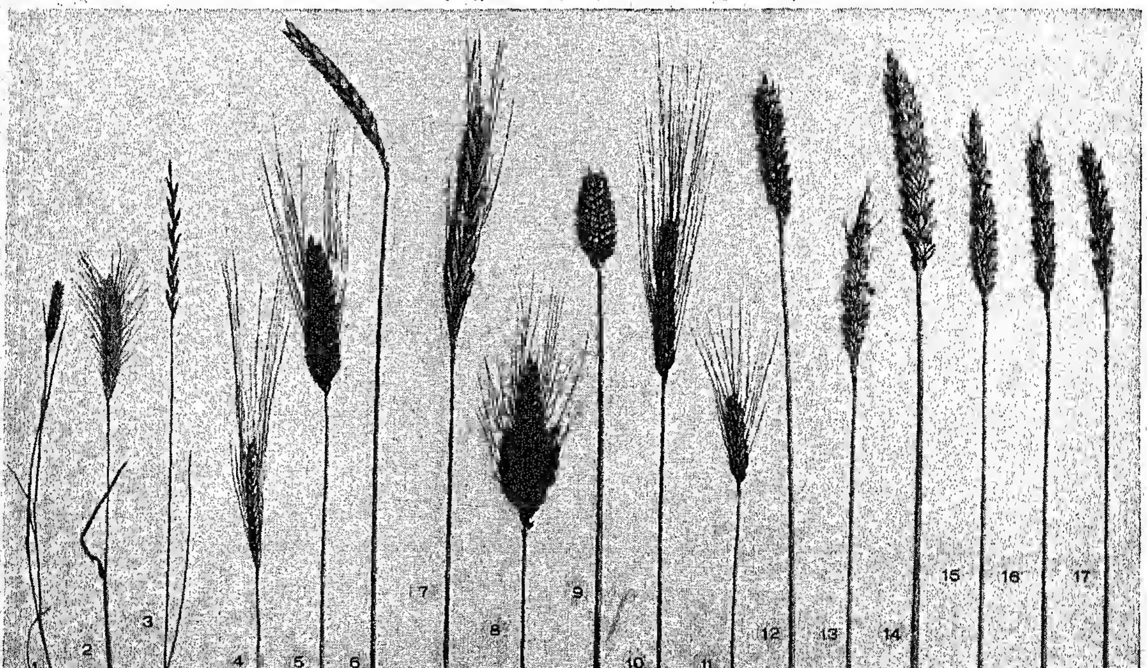
The Age-Old History of Wheat

Wheat cultivation is woven through the entire history of civilization. Swiss lake dwellers grew wheat perhaps 10,000 years ago. The Egyptians grew it long before the Pyramids were built. In Mesopotamia specimens have been found that were put in storage some 3,000 years before Christ. The Chinese grew wheat at least as early as 2700 B.C.

Wheat from Egypt fed ancient Greece and Rome, and its cultivation spread far and wide through Europe in the Middle Ages. It was brought to the New World after Columbus discovered America. The Spaniards introduced it into Mexico, and English colonists brought it with them to Jamestown.

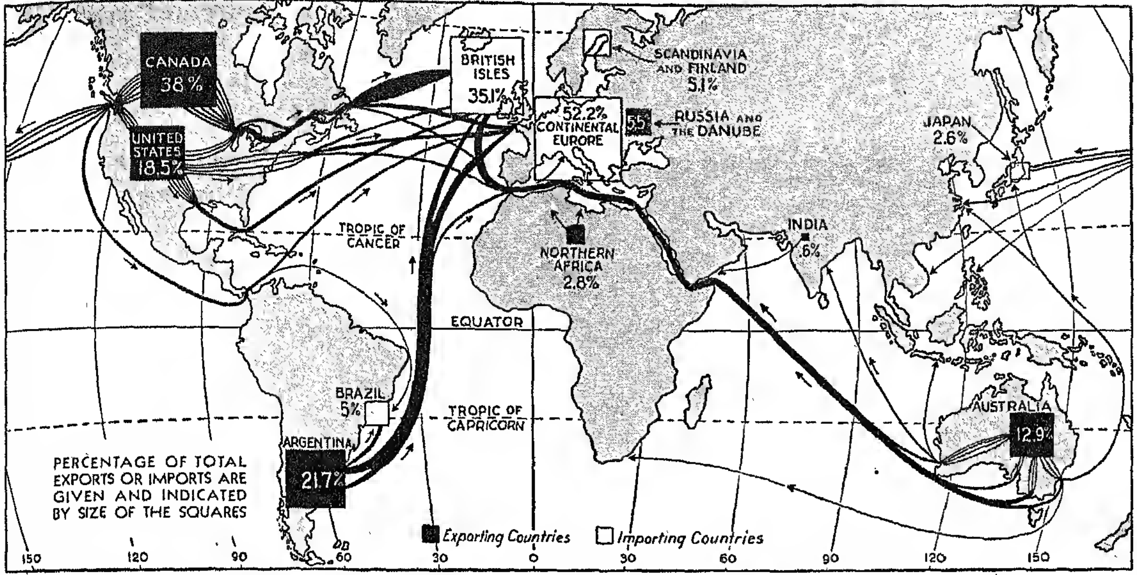
While they were clearing away the forest east of the Mississippi, however, the American colonists and

OLD AND NEW VARIETIES OF WHEAT



Here are the various primitive and cultivated wheats and the types of wild grasses from which they sprang: (1, 2, 3) wild grasses related to wheat; (4, 5, 6) Einkorn, Emmer, and Spelt, the primitive wheats grown by the ancients and still raised in mountainous parts of southern and eastern Europe; (7) Polish; (8) Poulard; (9) Club; (10) Durum; (11) Turkey; (12) Wilhelmina, a soft white wheat from Holland; (13) Pacific Bluestem, an Australian variety raised on the Pacific coast; (14) Dicklow, a soft spring wheat originated by Dick Low by selection from a club wheat; (15) Marquis; (16) Red Fife, one of the parent stems of marquis; (17) Kitchener, a hard spring wheat of Canada. Notice the beards, or awns, on durum, Turkey, and the primitive wheats.

THE WORLD-WIDE "NATURAL" FLOW OF WHEAT



This diagram shows how the world wheat trade is organized when tariffs and other barriers do not interfere with the tendency for densely settled regions to draw their wheat from the regions best fitted to produce it economically. The trade for the seasons of 1927–28 and 1930–31 is shown, since these were the last when the trade was not unduly restricted. Note that Europe is the great importing center, and that the chief growing centers are the world's great grasslands in the temperate regions. Abnormal conditions, such as price-fixing and crop failure or restriction, may temporarily disturb the normal flow of wheat.

pioneers preferred corn as a staple crop. Corn was easier to cultivate on poorly cleared land, and made a cheaper feed for animals, as well as for people.

The great era of wheat growing began when machinery, railroads, and steamships became common in the 19th century. Before then men had not been able to move wheat freely about the world. Transportation by steam power now enabled them to move wheat over vast distances; and a world-wide trade sprang up.

Wheat Growing Becomes a World Business

This new development was fortunate for the United States. Settlers in the Mississippi Valley found wheat an ideal "cash crop" to send east in payment for manufactured goods, just when McCormick's new reaper was enabling farmers to grow far more wheat with the same man power (*see* McCormick, Cyrus H.).

After the Civil War ended in 1865, settlers and railroads pushed west of the Missouri into one of the greatest potential wheat countries in the world. The flat land, free from trees, offered no obstacles to use of the new machinery. The soil was good and rainfall was sufficient for hard wheat. The railroads provided low-cost transportation, while the new ocean steamships were bringing freight rates down. These new aids enabled western American farmers to sell wheat in Europe at less than Europe's cost for home production. American exports, including flour figured as wheat, grew from 20 to 30 million bushels a year before the Civil War to more than 125 million bushels, and sometimes nearly 200 million bushels, a year.

Handling Wheat Crops

As production expanded, new mechanical methods of handling the wheat were developed. About 1842 the first grain elevator operated by steam was built in Buffalo, N. Y. After the Civil War, elevators sprang up over the whole wheat-growing region of the United States, while machinery took over planting and harvesting (*see* Grain Elevators).

Other new countries with open lands suitable for wheat now entered the wheat trade, and a wheat-shipping business grew up the world around. Elaborate business organizations were developed for marketing wheat (*see* Boards of Trade). Since the "world price" of wheat depends upon supply and demand and since the market at Liverpool is in the center of demand and shipping, Liverpool became the dictator of prices. Chicago and Winnipeg also became world centers because of their position in great areas of supply.

The Wheat Growers of the World

Before the first World War, production and supply balanced, and prices were satisfactory to producers and consumers alike. The world crop was normally about 3¾ billion bushels a year. Four-fifths of the crop was grown in the countries which consumed it. The rest was exported from countries which grew surpluses to countries which did not grow all they needed. About one-tenth of each crop was held for seed; about one-eighth was "carried over" as a floating supply and a reserve against a possible poor crop.

The greatest importers were the British Isles, Germany, and Belgium. The chief exporter was Russia. The United States, Canada, and Argentina came next.

The World War caused a huge expansion in wheat acreage in the United States and other countries outside Europe. After the World War, Russia ceased exporting until 1929. Canada became the leading exporter, and Argentina rose to second place after 1924. The United States crop averaged 829 million

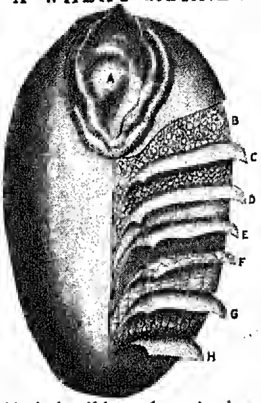
bushels in the decade 1919–30; but 500 million bushels a year were needed at home for food, and 85 million bushels for seed, so the United States took third place among the world's wheat-exporting nations.

The Wheat Problem

After the World War of 1914–1918, most European nations greatly increased their wheat acreage to lessen their dependence upon other nations and to reduce money payments abroad. The wheat-exporting countries ignored this situation, however, and by 1930 had piled up a carry-over that ruined market prices.

This condition worked particular hardship on American growers. By 1932 they were carrying over unused nearly half of a normal crop. The government tried to help the farmers by buying and storing immense quantities. Expecting this action to insure a good price, the farmers grew more wheat than ever.

A WHEAT KERNEL



At A in this enlarged view of a wheat berry we see the germ, or embryo, that would become a new wheat plant if allowed to grow. At B is part of the endosperm, or food material, consisting of starch and gluten. The remaining layers protect the berry in natural life, and form bran when the flour-mill rollers squeeze out the food material to make white flour.

In 1933 the government tried to stop overproduction by paying farmers to reduce their wheat acreage by 15 per cent. Devastating droughts in 1934, 1935, and 1936, however, reduced production and forced the United States for the first time in its history to import more wheat than it exported. By 1937 the world's carry-over was the lowest since 1919.

When overproduction again became a problem, the United States government in 1938 enlisted the coöperation of the farmers in a more extensive program for wheat control. It included acreage adjustment for soil conservation, and crop insurance, starting in 1939. To increase consumption, the government bought and held some surplus supplies. Subsidies were provided to aid exports by making up the difference between the American and the world price.

In 1939 the second World War cut off many European markets. Carry-overs increased enormously. This led the government in 1941 to set marketing quotas to control the amounts that growers could sell. In 1942 the United States, Canada, Argentina, Australia, and Great Britain agreed to set up postwar market controls. But in 1943 huge wartime demands forced the United States to suspend restrictions on both home production and imports. (*See also* Agriculture.)

Many Kinds of Wheat Plants

Wheat was domesticated in prehistoric times, and its origin is not known. Wild ancestors of the primitive einkorn and emmer types have been found in southeastern Europe, Syria, Palestine, and Ethiopia. Hence many scientists suppose that wheat growing originated in this region.

The cultivated plant is a slender annual of the genus *Triticum* in the grass family (*Poaceae* or *Gramineae*). From 5 to 20 hollow, jointed straws arise from a seed; each straw bears a zigzag head with several spikelets on each notch. Each spikelet bears several flowers; the flowers become wheat berries. Each spikelet and each flower is protected by a scale-like leaf or bract called a glume. Ripe wheat bears from 20 to 50 berries a head; threshing beats them out from the other structures, which form chaff.

Many varieties, notably the more primitive and hardier kinds, are bearded. The beard consists of an awn, or bristle, on each glume protecting a flower or berry. Durum and Turkey are the common North American bearded kinds.

The wheats most nearly resembling their wild grass ancestors are einkorn (*Triticum monococcum*) and emmer (*Triticum dicoccum*). Einkorn has one grain to a spikelet and emmer has two grains. Emmer is supposed by some scientists to be an ancestor of durum wheat (*Triticum durum*). The oldest known bread wheat is spelt (*Triticum spelta*) or dinkel. This has a brittle axis in the head and glumes that are hard to detach. Spelt was grown by the Romans and Egyptians; specimens have been found in mummy cases. Spelt is hardy and is still grown in upland districts of Europe. Other types are dwarf or club wheat (*Triticum compactum*); poulard wheat (*Triticum turgidum*); and Polish wheat (*Triticum polonicum*). Ninety per cent of the wheat grown in the United States is of the modern common type (*Triticum vulgare*).

Grades and Yields of Wheat

With abundant rainfall, soft winter wheats yield an average of from 12 to 16 bushels an acre, and hard spring wheats from 15 to 18 bushels. Pacific Coast yields average about 2 bushels more to the acre. These average figures take into account bad years and yields from poor soil. Wheat can yield well over 40 bushels to the acre.

The United States Department of Agriculture recognizes almost 250 varieties of wheat *plants;* but only about ten varieties are sown to more than a million acres each. The five official classes of wheat as *grain* are hard red spring, durum, hard red winter, soft red winter, and white. Each class has five grades. The first grade must weigh at least 58 pounds to the bushel; but hard spring must weigh 60 pounds. Only 14 per cent of moisture and 6 per cent of foreign matter, including other wheats, may be present. The fifth grade may weigh 50 pounds to the bushel, have 16 per cent moisture, and 17 per cent foreign matter. Lower or "sample" grades must be sold by sample. On most exchanges, the second grade is deliverable on futures contracts, with premiums or discounts for other grades.

The United States wheat crop has varied from the bumper crop of 1,025,801,000 bushels in 1915 to the record low yields of 427,553,000 bushels in 1893 and 496,469,000 bushels in 1934. A normal average is about 800 million bushels from about 60 million acres.

Wheat crops are reported from every state except Vermont, New Hampshire, Massachusetts, Connecticut, Mississippi, and Louisiana. The five states of Kansas, North Dakota, Nebraska, Montana, and Oklahoma usually produce more than half the crop. Washington, South Dakota, Texas, Illinois, Idaho, Ohio, and Indiana usually add more than a quarter. Oregon, Minnesota, Colorado, Pennsylvania, Missouri, and Michigan produce about 15 per cent. The violent changes in rank among states west of the Mississippi due to crop failures because of drought, wind damage, and pests, justify the statement that here wheat is a "gambler's crop." Kansas, however, always leads.

The Food Elements in Wheat

Wheat contains approximately 10 per cent water, 14 per cent protein, 2 per cent fat, 72 per cent carbohydrates, and 2 per cent ash. The proportions vary among varieties. Most of the carbohydrate is starch; the protein, called *gluten*, is composed of gliadin and glutenin. The germ contains the fat, or oil, and vitamins B_1, B_2, E, and G. Bread retains these food values, except that the vitamins are lost unless the bran and the germ are used. (*See* Bread and Baking. *See also* **Wheat** in the FACT-INDEX at the end of this volume.)

WHEEL. Take away the wheel and most of the world's work would stop. Automobiles, trains, streetcars, farm machines, wagons, and nearly all factory and mine equipment would be useless wood and metal. On land, loads could move only on sleds or the backs of men and animals. Almost anywhere we can find examples to illustrate how greatly our modern civilization depends upon the wheel.

Yet no one knows when the wheel was invented or who invented it. The best guess is that this happened "somewhere in Asia" about ten thousand years ago. The oldest wheel we know about was discovered in Mesopotamia and is believed to date back 55 centuries (*see* Transportation). But this wheel is evidently the result of long development. Can we imagine how that development started and how it grew?

The puzzle is at the start. After the idea of the wheel entered the minds of men, it was easy enough to make crude wheels by cutting sections of logs or by weaving hoops of twisted reeds supported by cross braces. But how did the wheel idea first arise?

The pictures at the right show what probably happened. Very early in man's history, he found out that a heavy load could be moved rather easily if a roller was put under it. Perhaps earlier, perhaps later, he discovered that runners under a load made it easier to drag, and so the sledge was invented.

Combining the roller and the sledge for very heavy loads is believed to have been the next step. As the sledge moved forward over the first roller, a second roller would be placed under the front end to carry the load when it moved off the first roller. In the Smithsonian Institution in Washington, D. C., is the model of a sledge with rollers copied from an old painting in the Temple of Luxor near Thebes.

We may imagine that after long use the sledge runners would wear grooves in a roller. Thereupon some primitive engineer must have observed that with a deeply grooved roller the sledge moved forward a longer distance before the roller needed to be shifted. An example shows why this is true. Suppose the circumference of the roller were four feet, but the grooves were worn until their circumference were only two feet. Then, for each turn, the roller would move four feet over the ground, but the sledge runners would move forward through the grooves only two feet.

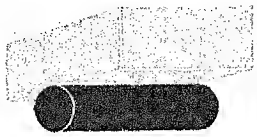
The Roller Turns into Wheels

The next step shows the change of the roller into a true wheel. Notice that the wood between the grooves of the roller has been cut away to make an axle, and that wooden pegs have been driven into the runners on each side of the axle. The runners can no longer roll forward. Instead, when the wheels turn, the axle revolves in the space between the pegs, slipping against the wood above them. This makes a primitive cart.

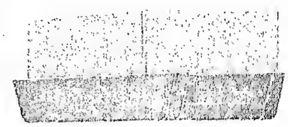
The last picture on this page shows how the primitive cart was improved. In place of the pegs, holes for the axle were bored through the frame of the cart. Axle and wheels were made separately instead of in one piece. The wheels were simply sections cut from a log. At first, the wheels were firmly fixed on the axle, and it was the axle that turned in the holes of the cart frame. Grease may have been used to reduce friction. Later, the axle was fastened so that

Wheel I

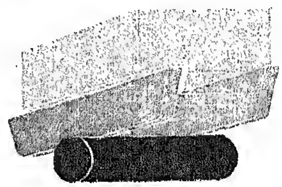
The Invention of the Wheel



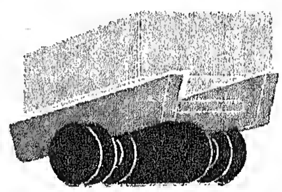
Roller



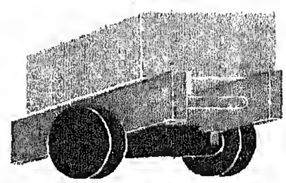
Sledge



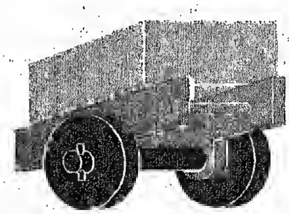
Sledge on roller.



Sledge on roller
which has become grooved with use.



Wheels and axle in one piece.
The axle fixed by pegs.

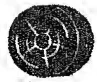


Wheels joined to axle.
Axle fixed into crude bearing.

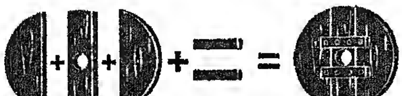
it could not turn, and the wheels revolved on its ends. This was a great improvement. When the wheels revolve on a fixed axle, it is much easier to make turns.

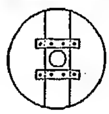
Wheel II

The Development of the Wheel

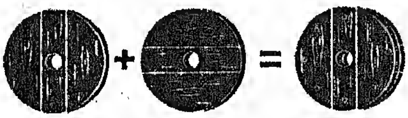


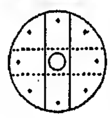
A disc cut from a log.



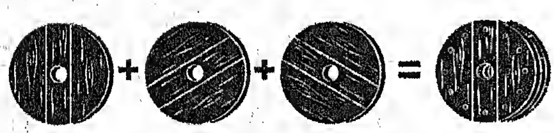


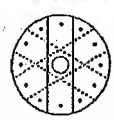
A disc of larger diameter composed of three boards, held together with cleats and wooden pegs.





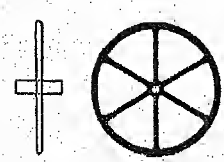
Two discs »sandwiched«, grain of wood crossing at right angles.





»Three-decker sandwich«, grain of wood crossing at angles of 60 degrees.

The middle boards of the primitive wheel suggest six spokes. How rim was developed is not known.



Wheel with six spokes, rim and hub. Large hub keeps the wheel from wobbling.

Then the outside wheel can revolve more rapidly than the inside one, instead of slipping when going around corners. We all know how railway and street cars screech on turns. That is because they mostly use one-piece wheel and axle construction for strength.

Improvements in the Wheel

By the time that wheels were made separate from the axles, the wheel *idea* was fully developed. What remained to be done was to improve the structure of the wheel itself. The drawings on this page show various ways of building up wheels to make them stronger and longer wearing than the plain slice from a log.

The final steps in producing a wheel of modern design are suggested by the last drawing. Here we have a wheel composed of three essential elements—hub, spokes, and rim. The hub is long to provide a bearing that will not wobble on the axle. The spokes are separately made, with one end of each fastened into a socket in the hub, the other end into a socket in the rim. The rim is itself made of six curved pieces of wood (called "fellies" or "felloes"), which together form a complete circle. The ends of these fellies are firmly joined with straps, dowel pins, or lap joints.

This type of wheel made its appearance in Egyptian chariots of about 2000 B.C. At this time, wheels for carrying heavy loads were still of the solid type. The spoked wheel was not strong enough until men learned to bind the rim and hold the fellies together with overlapping strips of metal serving as a tire. And many centuries passed before the spoked wheel reached its maximum strength with a tire made in one piece—a hoop of iron or steel, heated red-hot and shrunk on to the rim of the wheel as it cooled.

The Assyrians appear to have kept pace with the Egyptians in the use of the wheel. The Greeks got the wheel from Egypt and added a few improvements. It was the Romans who developed the greatest variety of wheeled vehicles that any people have ever possessed. They had chariots for war, hunting, and racing, two-wheeled farm carts, covered carriages, and fashionable gigs, heavy four-wheeled freight wagons and passenger coaches. Until the modern invention of pneumatic rubber tires and ball and roller bearings, there had been few improvements in the wheel itself since Roman days.

Of wheels in the New World before the white man's arrival no trace has been found. Why the ingenious and otherwise highly developed Incas and Aztecs failed to make this simple invention no one can tell. The fact that they had no draft animals may be part of the explanation. We can only guess at how much further they might have advanced, if their civilizations had had wheels on which to roll forward.

WHIPPOORWILL. Almost every one knows the three whistled notes—*whip*-poor-*will*, *whip*-poor-*will* —that give this bird its name. Its noiseless flight, as it combs the air at night for insects, gives an uncanny touch to its plaintive, insistent call. John Burroughs once heard a whippoorwill call 1,088 times in an hour.

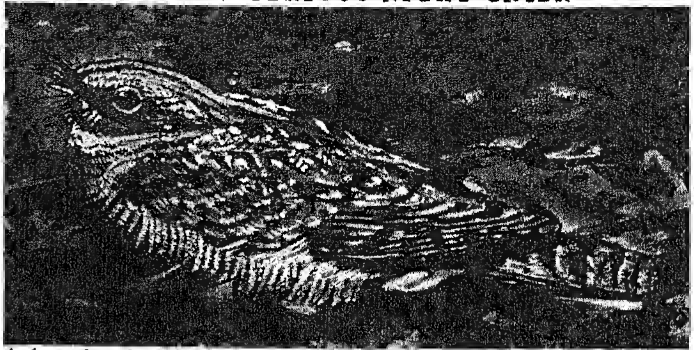
To see a whippoorwill is rarer than to hear one, for in the daytime this bird, which is about the size

of a robin, sleeps on the ground in the woods, where its dull mottled plumage blends with the leaves and grasses (*see* Birds; Protective Coloration).

Whippoorwills summer in the United States and Canada, and spend the winter in the Gulf states, Mexico, and Central America. They belong to the "goat-sucker" family *Caprimulgidae*.

Scientific name of whippoorwill, *Antrostomus vociferus*.

THE MYSTERIOUS NIGHT CRIER



A shy and modest bird is the Whippoorwill; but it is also a persistent creature; hour after hour it keeps pleading in the darkness for someone to "Whip-Poor-Will." While its beak is very short, its mouth is very large, permitting the bird to scoop in insects as it darts through the night air.

WHIRLPOOL. "The edge of the whirl was a broad belt of gleaming spray; but no particle of this slipped into the mouth of the terrific funnel, whose interior, as far as eye could fathom it, was a smooth, shining, and jet-black wall of water, inclined to the horizon at an angle of some 45 degrees, speeding dizzily round and round with a swaying and sweltering motion, and sending forth to the winds an appalling voice, half shriek, half roar, such as not even the mighty cataract of Niagara ever lifts up in its agony to Heaven."

It is thus that Edgar Allan Poe pictures the Maelstrom, that terrific whirlpool off the coast of Norway. The whirling motion is given to such an eddy or vortex of water by the meeting of two currents, by a current striking against a peculiarly formed bank, or by the activity of strongly opposed winds. In the case of the Maelstrom, the spinning motion is formed by tidal currents, which in stormy weather become so violent that they greatly endanger navigation. The onslaught of the torrent below Niagara Falls has worn a great circular basin out of the line of the river's course, thus forming that wilderness of howling spinning surge, the Niagara Whirlpool. These are probably the two most famous whirlpools in the world.

WHISTLER, JAMES ABBOTT MCNEILL (1834–1903). "If silicon had been a gas, I might have become a general in the United States Army," remarked James Whistler years after he had become a world-famous painter and etcher. Whistler, who was born at Lowell, Mass., of an old military family, entered West Point Military Academy when 17. But young James loved to draw so well he neglected his other studies. He remained there three years, but was dismissed after proving in an examination that he was entirely too hazy about identifying chemical elements.

Whistler then worked as a draftsman for the Coast Survey Department at Washington, but in 1855 he sailed for Europe and never returned to America. He studied in Paris for two years under G. C. Gleyre, a well-known artist.

Whistler realized that colors have certain powers of expression, and gave special heed to the fine arrangement of his color tones. Emphasizing the analogy between color and music, he borrowed names from the field of music to describe his pictures, calling them "nocturnes," "arrangements," "symphonies," and "harmonies." For instance, he named the famous portrait of his mother 'An Arrangement in Grey and Black'. Although this classification is accepted today, Whistler was laughed at and severely criticized for it at that time. Indeed, during his life he was more noted for wranglings with critics and for sharp satirical wit than for his work.

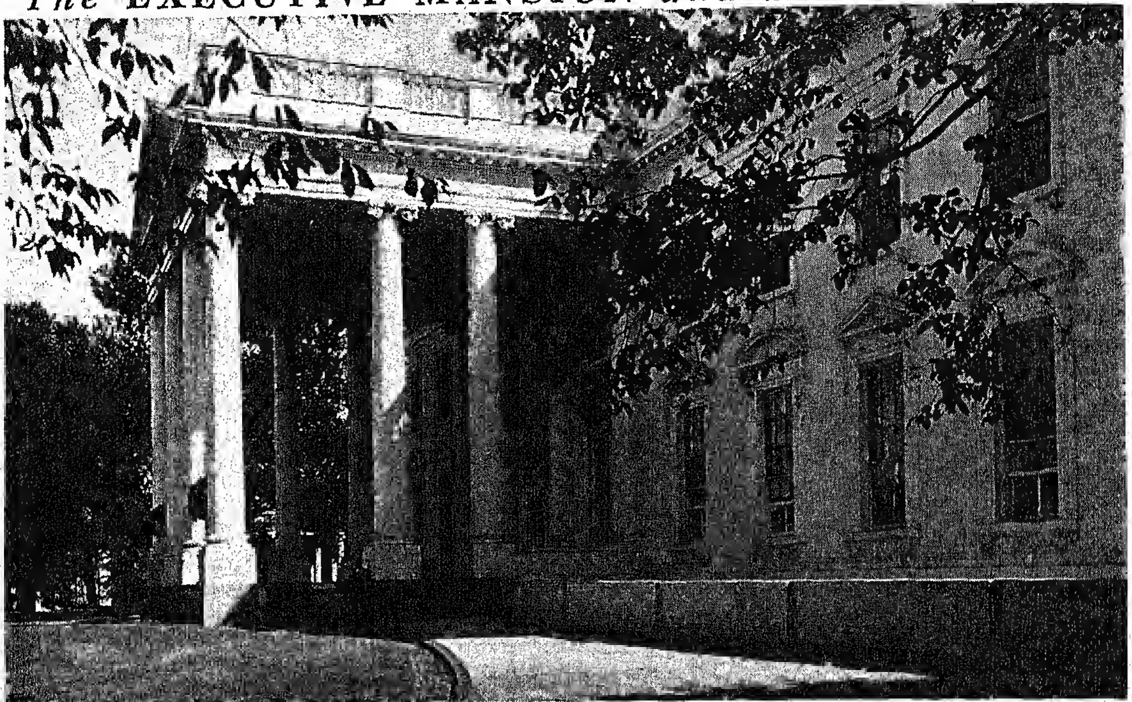
In his own individual way Whistler was a follower of the French impressionist movement (*see* Painting). He avoided brilliant colors, and his pictures are characterized by an absence of detail. His Nocturnes, which usually depict moonlight scenes on water with the lights along the shores shining dimly through the mist, illustrate this impressionistic tendency. In 1877, Ruskin wrote about the 'Nocturne in Black and Gold' or 'The Falling Rocket', for which Whistler asked 200 guineas, "I never expected to hear a coxcomb ask 200 guineas for flinging a pot of paint in the public's face." Because of this criticism Whistler sued Ruskin for libel, and received one farthing for damages. He flaunted this coin on his watch-chain ever after.

Whistler produced about 400 etchings and dry-points, and nearly 150 excellent lithographs. This versatile genius also wrote several delightful books; one, 'The Gentle Art of Making Enemies', is a charming work of wit and satire directed against his critics.

Whistler was honored by many governments during his life, and lived to see his work widely exhibited.

WHITEFISH. In lakes of northern Europe, Asia, and America live the whitefishes that are so often used for food. The common whitefish (*Coregonus clupeiformis*), with its cousins—the lake herring or cisco, and the chub—forms the most valuable fish family of the Great Lakes. It averages four pounds and may grow two feet long. Because its mouth is toothless and very small, it feeds on tiny creatures such as crustaceans, snails, and insect larvae. It lives in deep water and seldom enters the shallows except to spawn in late fall. The female deposits 10,000 to 75,000 eggs, but mud puppies and small fishes eat most of these. Whitefish are netted for market in such numbers that they are decreasing, although state and federal hatcheries plant millions of young each year (*see* Fish Culture).

The EXECUTIVE MANSION *and Its* HOSTESSES



The simple and unpretentious dignity of the White House makes it an appropriate residence for the republic's chief executive officer. It is a perfect type of the late 18th-century Renaissance style of architecture.

WHITE HOUSE. Almost as old as the nation itself, the gracious white mansion at 1600 Pennsylvania Avenue, in Washington, D.C., is an enduring symbol of the triumphs and tragedies of the American people.

James Hoban, an Irish-born architect, designed the building, and in 1792 the cornerstone was laid on the site chosen by Major L'Enfant, who planned the Capital city. John and Abigail Adams had the honor of being its first residents in 1800, and also the discomfort of shivering in its bleak, unfinished rooms. Mrs. Adams had to use the now magnificent East Room to hang out the family washing.

When the British burned the "president's palace," Aug. 24, 1814, Hoban rebuilt it, following his original plans. The gray sandstone walls were painted white to cover the smoke stains. The term "White House" did not become official until Theodore Roosevelt's administration, although it had long been in popular use.

The main entrance with its dignified portico of Ionic columns faces Pennsylvania Avenue and Lafayette Square to the north. From this side, the building appears to be only two stories high; but an attic floor is concealed by a crowning balustrade, and there is a ground floor apparent only from the sloping south side. The less familiar south façade, with its semicircular portico, overlooks a beautiful park of broad lawns, flower gardens, and wooded groves. This is considered the private park of the president and his family, and is open to the public only on Easter Monday for the children's egg-rolling festivities. The grounds cover 18 acres.

The main building is 170 feet wide by 85 feet deep. Long, low galleries extend from either side, with terraced roofs which provide promenades at the main floor level. The public enters the White House by the East Terrace. At the end of each terrace is a three-story executive office building.

The main floor of the mansion is used for the great dinners and receptions given by the president. The East Room is open to the public. In order to view the other rooms on this floor the visitor must obtain special permission. The second floor is the president's residence. Before the major remodeling in Theodore Roosevelt's administration, this floor held the executive offices, leaving little privacy for the family. Bedroom space was so inadequate that four of the Roosevelt children are said to have slept crosswise on the nine-foot Lincoln bed.

Millions Spent in Remodeling

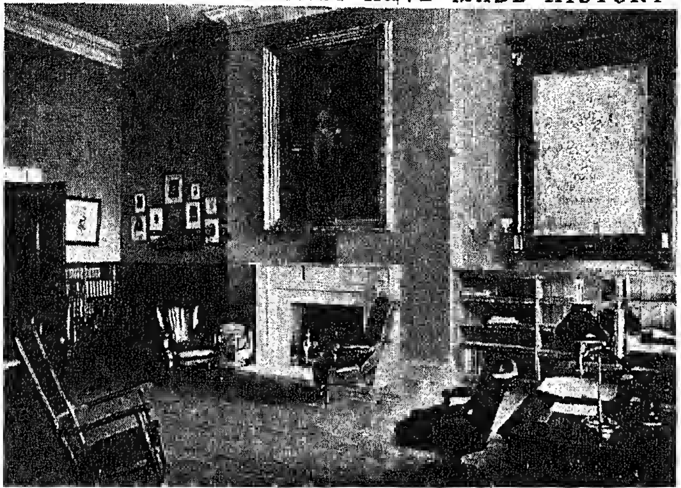
In the sweeping renovations of 1902, the Executive Office Building was constructed and many other improvements were effected. In 1927 the roof and attic were rebuilt, and in 1935 the ground floor and kitchens were remodeled. The executive offices were enlarged for the third time in 1934.

Repairs and the annual appropriations for upkeep have added millions of dollars to the original cost of only $200,000. President and Mrs. Monroe set the style for the interior decoration of the mansion when

they brought from France the gilt and satin furniture popular in the 18th century, as well as more solid Empire pieces, to replace that burned in 1814. Every president and first lady since then has made some changes and replacements to suit personal taste or the fashions of the day. Architects of the 1902 renovation returned to the French 18th-century style of interior decoration, and asked that this style be retained as best suited to the type of architecture.

Many of the upstairs rooms of the White House have been used at different times for different purposes, and their decoration has changed with the occupants. For a while the room now known as the Large Blue Room was used as the president's study. Over the mantel is this inscription: "In this room Abraham Lincoln signed the Emancipation Proclamation of January 1, 1863, whereby 4,000,000 slaves were given their freedom, and slavery forever prohibited in the United States."

WHERE THE PRESIDENTS HAVE MADE HISTORY



Many a history-making scene has occurred in this room, which is now called the Monroe Room. It was for many years the meeting place of the Cabinet. The mantel over the fireplace bears the following inscription: "This room was first used for meetings of the Cabinet during the Administration of President Johnson. It continued to be so used until the year MCMII. Here the treaty of peace with Spain was signed."

Other upstairs rooms include the bedrooms and dressing rooms of the chief executive and the first lady, the family sitting room, and several suites for the family and their guests.

Social Customs and Precedents

Large, formal, and arranged according to rigid rules of precedence, the presidential social functions bring most of official Washington into the spacious state apartments on the main floor each season. Other hostesses must wait to plan their parties until the first lady's schedule appears, since an invitation to a White House dinner carries the weight of a command. Those honored must cancel other dinners, even their own, when the president's messenger appears bearing a gilt-crested summons.

In the mammoth state dining room, decorated in the Georgian manner, with oak paneling, stone fireplace and chimney, and ceiling of stucco bas-relief, 100 or more guests may dine at a horseshoe table on gold plates or from one of the sets of executive mansion china selected by its successive hostesses. The chandelier and the wall sconces are of silver. Rug, draperies, and upholsteries are green. The dinner partner and the place of each guest—whether near the president and his wife, or far down toward the end of the table—depend upon his rank in the government. The four traditional official dinners each season honor the Cabinet, the Supreme Court, the Speaker of the House, and the foreign diplomats. Mrs. Hoover added a fifth, a dinner to the vice-president.

Official receptions are more numerous. Let us attend, in imagination, the most colorful of them all—that to the foreign diplomats. As many as 2,700 invitations sometimes go out for these great affairs. Colored cards sent to high officials permit them to ride up under the *porte cochère* and enter the north door, passing by the president's seal embedded in the foyer floor. Since we have no special card, our entry is through the east corridor, and we mount the steps to the great hall where the Marine Band is playing. The line of guests winds through the state dining room on the west, and turns east into the Red Room, its walls rich with red damask. In this room, once known as the Washington Room, hung the portraits of George and Martha Washington, now in the East Room. The picture of the first president was rescued by Dolly Madison when the British burned the White House in 1814. The mantelpieces in this and the Green Room are part of the original fixtures of the "president's palace."

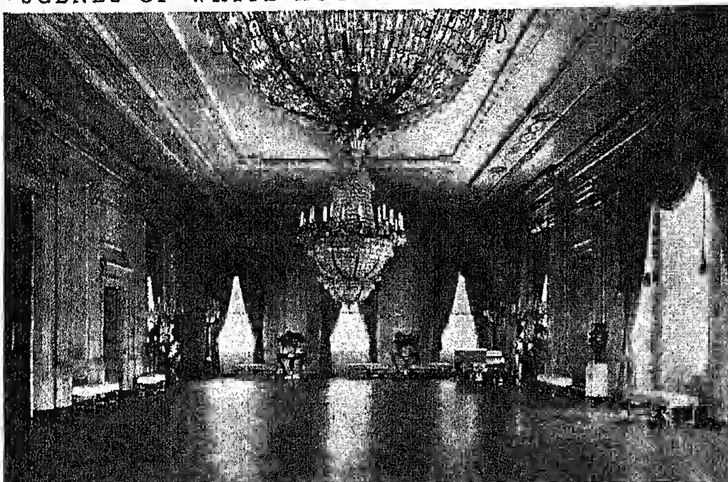
A Reception in the Blue Room

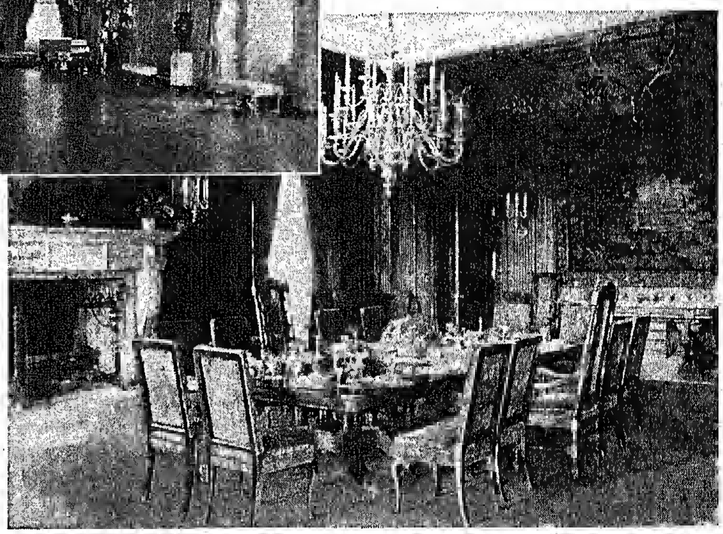
Next we come to the oval Blue Room, where newly arrived diplomats first meet the president and present their credentials. We see the president and his wife silhouetted against the blue silk walls, standing in the bay of the tall south windows. At his elbow stand a bodyguard and the military aide who asks the guests' names and repeats them to the president. There is a brief handshake with the president and the first lady; and the line pushes forward. We glance hastily at the quaint Minerva clock and candelabra on the mantelpiece, made for President Monroe in France, as we pass into the Green Room, with its walls of Genoese velvet. Among the ornaments that have graced this room, as passing administrations have made their changes, are the gilt-framed screen, whose canvas is said to have been worked by the Austrian empress; the cabinet brought over by the first Japanese embassy; and a pair of large Satsuma vases from Japan.

The line breaks up beneath the great crystal chandeliers of the East Room. We can give little

attention to the foreign guests in their court uniforms, for the historic room itself commands our interest. It is a spacious hall 87½ feet long by 45 feet broad, with low-relief wall panels depicting Aesop's fables, gold damask draperies, gilt chairs, and an ornate grand piano. This room has been the

SCENES OF WHITE HOUSE POMP AND PAGEANTRY





In the East Room (above) with its marble busts, its Royal Sèvres vases, its gold damask draperies, and its low-relief wall panels depicting Aesop's fables, the Marine Band on formal occasions plays for the dancers. State dinners, at which rank governs one's place at the table, are served in the English oak-paneled dining room (right). Next to the East Room, this is the largest room in the White House. A small family dining room opens into it.

scene of many festive and tragic gatherings, of White House funerals and weddings, and receptions to royalty. King George VI and Queen Elizabeth of England were entertained here in 1939, and the King's grandfather, Edward VII, then Prince of Wales, was received in the same room by President Buchanan. We may dance, or walk on the promenade roof of the East Terrace, until the signal is given that the evening's entertainment is at an end.

Among other receptions are those to the judiciary, the Senate, the House, and the Army and Navy. The great public New Year's Day reception, started by George Washington, imposed too great a strain on the president, and was abandoned by Franklin Roosevelt.

The number of afternoon teas, musicales, and garden parties given by the first lady depends upon her tastes and health. The chatelaine of the executive mansion belongs to the nation almost as much as does her husband. Her engagement book overflows with official appointments—ships to christen, charities to patronize, and callers to receive. She accompanies her husband on his official trips and public appearances, and is hostess for their extensive formal and informal entertaining. She needs a housekeeper to manage this great household, and a social secretary to assist with her correspondence, her engagement calendar, and the knotty problems of precedence that state social affairs present. She has little time for her friends and her personal interests. The fierce light of publicity beats upon her and every member of her family. Secret service men guard them at all times. The White House police watch their home and grounds.

Convention hedges the president and his wife on every side. They may not accept invitations other than to the formal dinners tendered them by the vice-president, the cabinet, and the speaker of the house. They do not pay formal calls, except upon friends who are very ill or upon a visiting dignitary of equal rank—a president or king of another country. Even close friends of the president or of the president's wife must write to their secretaries for an appointment to call.

It costs about a half million dollars each year to support the chief executive in the style he should maintain. Besides his annual salary of $75,000, and the $25,000 he draws for travel and state entertaining, more than $100,000 is appropriated for the upkeep of the White House. This sum covers the payroll of the large staff of employees, supplies, repairs, and refurnishing. The employees include the chief usher and his assistants, the housekeeper, ladies' maids, the president's valet, doorman, engineers and maintenance men, telegraph and telephone operators, butlers, cooks, chambermaids, secretaries, gardeners, chauffeurs, police, secret service men; and personal, military, and naval aides to the president. The Executive Office Building has its own staff. Extra waiters and kitchen help are hired for large dinners. Usually about 3,000 guests are entertained at meals each year, and the visitors number about a million.

Hostesses of the White House

THE social life of the White House forms an important part of the history of the United States. The "First Ladies" of the country have had a conspicuous part not only in helping to further the careers of the presidents but also in shaping the course of events during their administrations. The lives of these women are of interest not only for their own sake, but also for the many illuminating sidelights they flash on the course of history. The hostesses of the White House have usually been the wives of the presidents, but other near relatives—daughter, sister, or niece—assumed this duty for widowed or bachelor presidents.

Martha Dandridge Washington (1732–1802). Although the White House was not finished until after George Washington had been succeeded by John Adams as president, and hence Martha Washington never lived in it, she was nevertheless America's first "first lady," and is included here to make the list of "first ladies" complete. She set a high standard for all who came after her as presidents' wives by a life that was always kindly, helpful, gracious, and dignified. Whether at Mt. Vernon, Valley Forge, or in one of the early executive mansions, Mrs. Washington kept, in her own words, "busy as a bee, cheerful as a cricket, and steady as a clock." Small, plump, dark-haired, and hazel-eyed, this daughter of wealthy Col. John Dandridge ruled as belle of Williamsburg, Va., when she married Daniel Parke Custis. He died in 1757, leaving her with two children. Two years later, Mrs. Custis gave her hand to Col. George Washington, and went to be the mistress of his great Mt. Vernon estate. Up at dawn to direct the servants, superintend the sewing-room with its 16 spinning wheels, and to dispense lavish hospitality to a stream of visitors, Mrs. Washington's every moment was filled. Beginning in 1775 when Colonel Washington took command of the Continental Army, she kept even busier for eight years, overseeing the farming of thousands of Virginia acres, and spending the winter at Washington's headquarters. She rode on a pillion with him on his big bay charger to Valley Forge, following the bloodstained trail made on the snow by the bare feet of the soldiers. During that memorable winter she carried food to the sick, banded together the wives of the officers into a daily sewing circle for the soldiers, and cheered the army by her frequent visits into the camp. In 1789, tired and wanting only the quiet of Mt. Vernon, she again answered duty, and took coach to New York. Throughout the long slow journey, grateful Revolutionary veterans everywhere cheered her as "Lady Washington." In the temporary capitals of New York and Philadelphia, her courtly levees set many precedents to be followed by later first ladies, in the White House that was then rising in the woods along the Potomac.


Martha Washington

Abigail Smith Adams (1744–1818). "No man ever prospers without the consent and coöperation of his wife," Abigail Adams once said, and none had a better right to say it, for this pioneer New England daughter, trained in hardihood and self-reliance, was a true helpmeet to her husband. With John Adams almost constantly away from home in conventions and congresses, or abroad on diplomatic missions, Abigail managed the rocky little farm near Quincy, Mass., taught her children and nursed them through pestilences, made all the family clothes, and shared her scant portion of food and grain with needy neighbors. Her letters to her absent husband are full of shrewd observations on human nature and public affairs, and paint a sharp picture of life and thought in the revolting colonies and the infant republic. In November 1800, she moved from the temporary capital in Philadelphia to the "wilderness city" of Washington. Though a semi-invalid, she held sprightly levees in the half-finished, barren White House; acted as advisor to her husband; and was not above drying the family wash in the gaunt East Room. Mrs. Adams was the only woman who was both wife and mother of a president, although she died before her son became president. The daughter of the Rev. William Smith, a Congregational minister, Abigail married John Adams in 1764.


Abigail Adams

Martha Wayles Skelton Jefferson (1749–1782). Frail, charming Martha Jefferson died 19 years before her husband became president. Daughter of John Wayles, of Virginia, and widow of Bathurst Skelton, she married Thomas Jefferson in 1772. Of their five children, but three lived to comfort the lonely years of their father, who, in compliance with his wife's wish, never remarried. Two daughters, Mrs. Thomas M. Randolph and Mrs. John Wayles Eppes, acted as White House hostess during visits to Washington.

Dorothea Payne Todd Madison (1768–1849). At 33, gay, dark-haired Dolly Madison made her bow to the official society of Washington, entering on the arm of President Jefferson. At 81, still gay, still "Queen Dolly," she bowed her way out, leaving on the arm of President Polk. The daughter of John Payne, a Virginia Quaker, she had been reared in the strict principles of the Society of Friends; but she wore a tiny bag of old-fashioned jewelry, secretly given her by her grandmother, hidden under her Quaker kerchief. In 1783, the family moved to Philadelphia, and there Dolly married John Todd, who died in 1793. A year later, Aaron Burr, one of her mother's boarders, introduced Mistress Dolly to "the great little Madison." Married to Madison, she embarked on the social career for which her vivacious nature was so well fitted, despite her Quaker training. From 1801 to 1809 she was frequently hostess for President Jefferson, and when her husband was elected to succeed


"Dolly" Madison

that president, Dolly quickly became one of the most noted chatelaines that ever graced the executive mansion. Political differences were forgotten at her gay levees, and her cordial hospitality made many friends for her husband's administration. In her velvet and satin gowns, her Paris turbans, embroidered slippers, and pearls, Dolly ruled fashionable society, yet found time to cut hundreds of garments for the children of the capital's orphan asylum. British raiders burned the executive mansion in 1814, and Dolly fled with a bag full of state papers and the Stuart portrait of George Washington, hastily cut from its frame. The Madisons moved into the Taylor mansion (Octagon House), where returning soldiers of the War of 1812 loudly cheered "Queen Dolly." Retiring to the Madison estate, Montpelier, in Virginia, at the end of two terms, Dolly lived there with her husband until his death in 1836. Then she returned to Washington, where on New Year's Day and the Fourth of July, people who attended the presidential receptions trooped across the square to pay respects to the aging, but still queenly Dolly.

Elizabeth Kortright Monroe (1768–1830). "La Belle Américaine," Paris called Mrs. Monroe, who came to the remodeled executive mansion, painted white to cover its smoke stains. She was the daughter of Lawrence Kortright, an English army captain who had remained in New York after the Revolution. She was married to James Monroe in 1786. When he went as minister plenipotentiary to France, Elizabeth accompanied him, and their daughter attended school with Hortense Beauharnais, stepdaughter of Napoleon. While in Paris, Mrs. Monroe saved the life of the Marquise de Lafayette, who had been imprisoned by the Terrorists, and lay awaiting her hour of execution. "La Belle Américaine" called upon the prisoner, and her captors spared the marquise to preserve diplomatic friendships. When the Monroes reached the White House in 1817, their experience at Napoleon's court was reflected in the elegant French furnishings they selected for the mansion, and in the stately formality of the levees over which Mrs. Monroe presided during her husband's term of office.


Elizabeth Monroe

Louisa Johnson Adams (1775–1852). Another who came from Europe's brilliant courts to take her place in Washington society was Louisa Adams. First as wife of the secretary of state, then as mistress of the executive mansion, she helped her husband solve the thorny problems of precedence that already vexed the "republican court." John Quincy Adams, sent abroad on state business, met Louisa in the London home of her father, Joshua Johnson, an American in England on business. Immediately after their marriage, Adams went to represent America at the German court, and later changed to St. Petersburg, where Louisa ingeniously managed their small income to meet the demands of Russian royal entertainment. Next, government business took him to Paris, and Louisa crossed battle-torn Europe in 1815 to join him—journeying in carriages and sleighs, thawing frozen provisions, and eluding bandits. Despite her cosmopolitan background, Mrs. Adams was not all worldly, and her tastes were as literary and artistic as were those of her quiet husband.


Louisa Adams

Rachel Donelson Robards Jackson (1767–1828). After a long, stormy military and political career had finally carried Andrew Jackson to his coveted goal of president-elect of the United States, his wife, Rachel, died of a heart attack before inauguration day came to place her in the White House. She had been a sympathetic and beloved comrade to this fiery leader, and a strong and capable helpmeet who handled the Hermitage plantation while he was absent on military campaigns. The daughter of a Virginia surveyor, Col. John Donelson, she married Lewis Robards, of Kentucky, in 1783, divorced him, and married Andrew Jackson in 1791. Although handsome and vivacious, she had no desire for public life, and had said at the time of her husband's election: "For Mr. Jackson's sake, I'm glad; for my own part, I never wished it." Emily Donelson, niece of Mrs. Jackson, and wife of Jackson's secretary, Maj. A. J. Donelson, acted as White House hostess for "Old Hickory."


Rachel Jackson

Hannah Hoes Van Buren (1782–1819). Although she shared his school days, at Kinderhook-on-the-Hudson, and his struggling years as a young lawyer, Mrs. Van Buren did not live to see her husband attain the highest office in the government. She died in Albany, N. Y., 17 years before his election. Her place as White House hostess was taken by Angelica Singleton Van Buren, one of the real beauties of the executive mansion, and the bride of Van Buren's eldest son, Abraham. Introduced into Washington society by her cousin, Dolly Madison, this young daughter of a wealthy South Carolina planter was the belle of the capital. She brought some of the formality of Mrs. Monroe's régime back to the executive mansion.

Anna Symmes Harrison (1775–1864). Though she was the wife of one president and the grandmother of another, Anna Harrison never lived in the White House. The daughter of Col. John Cleves Symmes, she went to the wilderness of the Northwest Territory with her father at 19, and there met dashing Capt. William Henry Harrison, to whom she was married in 1795. Illness prevented her accompanying him to Washington for his inauguration, in 1841, and when she was preparing to follow him a month later from the Harrison home in North Bend, Ohio, news came of his death.

Letitia Christian Tyler (1790–1842). Like Abigail Adams, Letitia Tyler had a large part in forwarding the career of her husband. She gleaned from her Virginia plantation an income to supplement his small government salaries as a congressman, United States senator, and office holder in Virginia. The daughter of Robert

Christian, of Cedar Grove, Va., she married brilliant and ambitious John Tyler in 1813. Busy overseeing her estate and caring for a family of seven, she discovered little time for social life; but guests found her a thoughtful and gracious hostess.


Letitia Tyler

Because of her illness during her stay in the White House, the duties of official hostess fell upon her daughter, Letitia Tyler Semple, and her daughter-in-law, Priscilla Cooper Tyler. She died in 1842.

Julia Gardiner Tyler (1820–1889). Washington society knew Julia Gardiner first as the daughter of Senator Gardiner of New York. Her father was one of those killed when a big gun on the battleship, *Princeton*, exploded with the president, his cabinet, and a party of guests on board. The bodies lay in state in the East Room, and President Tyler exerted himself to console Julia and her sister. They were married eight months before the end of his term, and Mrs. Tyler entertained brilliantly in the White House. Of their family of seven, a son, Lyon Gardiner Tyler, became president of William and Mary College.

Sarah Childress Polk (1803–1891). Unlike many women of her era, Sarah Polk took an intelligent interest in politics. When her husband became president, she served as his confidential secretary, a post never before held by a woman. Born in Tennessee, the daughter of Joel Childress, a well-to-do farmer, she enjoyed the best educational advantages of her day. Twenty-three years after her marriage to James K. Polk, they entered the White House. As a strict Presbyterian, she at once forbade dancing and the use of wine at her social functions. An English visitor wrote of her that not one of the European queens she had seen could compare with the regal appearance of handsome black-haired Mrs. Polk. Although her calm dignity and her formal correctness were somewhat awe-inspiring, she was greatly admired for her sincerity.


Sarah Polk

Margaret Smith Taylor (1788–1852). A log cabin in the winter and a tent in the summer were the homes from which Margaret Taylor, of Maryland, stepped into the White House. Refusing to be separated from her soldier husband, Margaret followed on all of his campaigns, sending her six children to school in "the settlements." When called to the executive mansion in 1849, she was living in the barracks at Baton Rouge, La. Untrained for the capital's formal social life, she delegated her hostess duties to her 22-year-old daughter, Betty Taylor Bliss, who presided over the mansion until the death of her father in 1850.

Abigail Powers Fillmore (1798–1853). Tall, scholarly, and musical, Abigail Fillmore commanded highest respect for the part she played in her husband's success. Before their marriage she had guided his studies in the little backwoods New York town that was their home; after their marriage, she continued to teach school so that he could be free to study law and seek public office. The daughter of the Rev. Lemuel Powers, of Stillwater, N. Y., she married Millard Fillmore in 1826. Her health was broken when she entered the White House, so she spent much of her time in retirement, studying in the new library which Congress placed in the executive mansion at President Fillmore's request. Her daughter, Abigail, an accomplished linguist and sculptor, assisted with social duties. After Mrs. Fillmore's death, the ex-president married Mrs. Caroline Carmichael McIntosh, of Albany, N. Y., in 1858.


Abigail Fillmore


Jane Pierce

Jane Appleton Pierce (1806–1863). Just two months before her husband's inauguration as 14th president, a railroad wreck killed Jane Pierce's son, a boy of 13. Two other sons had died in childhood. She and Mr. Pierce entered the executive mansion a stricken pair. Yet she strove to fulfill the duties of hostess, and fought down her grief to preside at all formal functions. This quiet, retiring New England woman was the daughter of the Rev. Jesse Appleton, president of Bowdoin College. She was married to Mr. Pierce in 1834.

Harriet Lane Johnston (1833–1903). At nine, orphaned Harriet Lane chose James Buchanan, her bachelor uncle, to be her guardian; when she had grown to charming young womanhood, he chose her to be official hostess to the only bachelor president. Learned in the ways of diplomatic society through residence with her uncle in Washington and London, her White House dinners and receptions eclipsed those of many other administrations. Particularly brilliant were the affairs in honor of Albert Edward, Prince of Wales, afterwards King Edward VII. Miss Lane married Henry Elliot Johnston in 1866.


Harriet Johnston

Mary Todd Lincoln (1818–1882). All of her life Mary Lincoln had hoped to be mistress of the White House, yet when she entered that mansion in 1861 she became its most lonely figure. President Lincoln was engrossed in the problems of the Civil War. Social life in Washington declined. Mrs. Lincoln's quick, nervous manner made few friends for her. The death of a son, Willie, brought grief to the family circle. A Kentuckian by birth, she was the daughter of Robert S. Todd, of

Lexington. In early womanhood she went to Springfield, Ill., to make her home with her sister, Mrs. Ninian Edwards, Jr., and it was there that she met Abraham Lincoln, who won her hand in 1842. Stephen A. Douglas, Lincoln's great political rival, also was her suitor. At the close of the Civil War, when Mrs. Lincoln looked forward to happier times in the capital during her husband's second term, the President was assassinated before her eyes. Broken by tragedy, she left the executive mansion to return to Springfield, the home of happier days. Of her four sons, only one grew to manhood—Robert Todd Lincoln, later secretary of war, ambassador to Great Britain, and president of the Pullman Company. "Tad" Lincoln, whose pranks in the White House enraged officials and amused the public, died in 1871.

Mary Todd Lincoln

Eliza McCardle Johnson (1810–1876). Married to Andrew Johnson, a young tailor's apprentice of Greenville, Tenn., when she was 16, Eliza Johnson had her shoulder to the wheel on every step of the long road leading to the president's chair. Andrew had no formal schooling, and the midnight oil burned in the little Tennessee home while Eliza, a mountain school teacher, taught him from well-thumbed texts. And then Mrs. Johnson was up early in the morning to care for a family of five. In the White House, she was an almost mythical figure, confined to her room by poor health. Her daughter, Martha Johnson Patterson, was mistress of the mansion.

Julia Dent Grant

Julia Dent Grant (1826–1902). Royal guests from Europe's proudest courts and lowly widows of Union soldiers shared in the bounteous hospitality Julia Grant dispensed in her eight years in the White House. This daughter of Judge Frederick Dent, of St. Louis, married Ulysses Grant when he was a young officer in 1848. After many years of hardship, struggle, and lack of financial progress on the part of her husband, she saw his chance come, and watched him rise to the command of the Union forces, and to the highest office in the gift of the nation. Her daughter Nellie's marriage to Algernon Sartoris, of London, was one of the mansion's famous weddings.

Lucy Webb Hayes

Lucy Webb Hayes (1831–1889). With Lucy Hayes, the "new woman" came to the White House. Born in Chillicothe, Ohio, the daughter of Dr. James Webb, she was a graduate of Wesleyan Female College, at Cincinnati. She was married to Rutherford B. Hayes in 1852. During her husband's term as governor of Ohio, she worked to enlarge the charities of the state, and was active in church projects. During the Civil War, her efforts turned toward the work for wounded soldiers. In the White House, her temperance principles led to her refusal to serve wine at the table. Despite her wide range of interests, her eight children had first claim upon her time, and the executive mansion was the scene of a happy domestic life in the years that she presided over it.

Lucretia Garfield

Lucretia Rudolph Garfield (1833–1918). Although she had lived in Washington during the long period that her husband served in Congress, Lucretia entered the White House almost a stranger to official society. While her husband held public office, she had devoted herself to her home, tutoring her five children, and entertaining but little. The Garfields had been schoolmates in Garrettsville, and had both taught school before their marriage in 1858. Mrs. Garfield was the daughter of Zeb Rudolph, a farmer. An assassin's bullet ended the stay of this gracious hostess and her happy family in the White House. Of this family, Harry A. Garfield became president of Williams College, and James R. Garfield was secretary of the interior.

Ellen Herndon Arthur (1837–1880). Just a few months before her husband succeeded to the presidency, Mrs. Arthur died. She was the daughter of Com. William Lewis Herndon, U. S. N., explorer of the Amazon. Her place as White House hostess was taken by Mrs. Mary Arthur McElroy, a sister of President Arthur.

Frances Folsom Cleveland (born 1864). At 22, just a year after her graduation from Wells College, Frances Folsom was married to Grover Cleveland in the lovely Blue Room, and had the honor of being the first White House bride of a president. The young first lady was the daughter of President Cleveland's former law partner, Oscar Folsom, of Buffalo, N. Y. Before their marriage, Rose Elizabeth Cleveland, the President's sister, had been his hostess. Mrs. Cleveland entertained brilliantly during both of her husband's terms. Her charming manner and her beauty made her a general favorite with the public as well as in official circles. She and Mr. Cleveland had five children; and Esther, their second daughter, was the first child of a president born in the White House. In 1908 Mr. Cleveland died, and five years later his widow married Thomas J. Preston, Jr.

Frances Cleveland

Caroline Scott Harrison (1832–1892). A college romance was Caroline Harrison's. She was the daughter of Prof. John W. Scott, of Miami University, Oxford, Ohio, and married Benjamin Harrison soon after his graduation from that institution. She was a musician


Caroline Harrison

and a painter, and interested herself in church and social work. The Daughters of the American Revolution elected her their first president-general. Mrs. Harrison died in the White House near the end of her husband's term of office.

Ida Saxton McKinley (1844–1907). With Ida McKinley came a "business woman" into the White House. When she married Maj. William McKinley, lately returned from the Civil War, she was cashier of her father's bank in Canton, Ohio. Though Mrs. McKinley was an invalid most of the time during her husband's term, she took her place at his side at state social affairs, and accompanied him on official journeys. She was with him at Buffalo, N. Y., when he was shot.


Ida McKinley

Edith Carow Roosevelt (born 1861). In 1886, two years after the death of his first wife, Alice Lee Roosevelt, mother of "Princess Alice," Theodore Roosevelt and Edith Kermit Carow were married in London. She was the daughter of Charles Carow, of New York. Though Mrs. Roosevelt entertained extensively in the White House, she is remembered by the nation not as a hostess, but as the ingenious and patient mother of the lovable "Roosevelt gang." The President's family, Alice, Teddy, Jr., Kermit, Archie, Quentin, and Ethel stirred the venerable mansion with their lively games and pets. Quentin, an aviator, died in the World War.


Edith Roosevelt

Helen Herron Taft (1861–1943). Missions of state had taken Mrs. Taft and her three children to the Philippines, Japan, China, Panama, Italy, France, and England, before they came to make their home in the White House. She was the daughter of John W. Herron, of Cincinnati, law partner of President Hayes. She was married in 1886. She was a musician, and organized and managed the Cincinnati Orchestra Association. Her daughter, Helen, wife of Prof. Frederick J. Manning, of Yale, had an outstanding career as an educator. Her sons, Charles B. and Robert A. Taft, are lawyers of note.


Helen Taft

Ellen Axson Wilson (1860–1914). Painting, drawing, landscape gardening, and social service interested Ellen Wilson more than official entertaining. The daughter of Rev. S. E. Axson, she was married to Woodrow Wilson, in Savannah, Ga., her birthplace, in 1885, and saw him resume studies at Johns Hopkins University, teach at Bryn Mawr, Wesleyan, and Princeton, become president of Princeton in 1902, governor of New Jersey in 1910, and win election to the presidency two years later. Of her three daughters, two were married in the White House—Jessie to Francis B. Sayre, an educator, and Eleanor to William G. McAdoo, secretary of the treasury during President Wilson's administration. Mrs. Wilson's health was frail during her stay in the White House, and she died there in 1914.


Ellen Wilson

Edith Bolling Galt Wilson (born 1872). The gracious and charming Edith Bolling Galt, of Virginia and Washington, was married to President Wilson in 1915. She shared with him the worry and grief of the World War years, as well as the honors bestowed on him at the Peace Conference in Paris. When his health broke down near the close of his administration, she nursed him until his death in 1924. In later years she continued to take a great interest in the League of Nations.


Edith Wilson

Florence Kling Harding (1860–1924). A business executive was Florence Harding, who had been for ten years manager of her husband's paper, the *Marion Star*. She was the daughter of Amos O. Kling, of Marion, Ohio, and had been married to and divorced from Henry De Wolfe prior to her marriage to Warren Harding in 1891. She was unable to enjoy long her position as first lady, because of a serious illness in the White House. The newspaper correspondents illustrate the stringency of presidential etiquette by an incident of the Harding régime. On entering an elevator, the courteous President stepped aside to allow his wife to precede him, but an attendant barred her way, saying "I beg your pardon, madam, but the President goes first." Mrs. Harding accompanied her husband on the trip to Alaska on which he died. Her death came little more than a year later.


Florence Harding

Grace Goodhue Coolidge (born 1879). Probably no

Grace Coolidge

mistress of the White House was ever more popular than Grace Coolidge. Charming in manner, thoughtful and gracious, she brought to the historic mansion a friendliness to which the nation responded and a smile that became famous. The daughter of Capt. Andrew I. Goodhue, of Burlington, Vt., she was a college graduate and a teacher in Clark Institute for the Deaf, Northampton, Mass., when she married Calvin Coolidge in 1905. The story goes that the little schoolma'am once visited the White House as a tourist and dared to tinkle the keys of the gold piano in the East Room, little dreaming that she would one day be hostess there. Her enjoyment of the large public gatherings she attended so frequently came from her liking for crowds, from whom she took the same enjoyment many people get from books. "People are my books," she said.

Lou Henry Hoover (born 1875). When Lou Henry entered Stanford University, her parents expected her to major in English; but instead she elected geology and mining; and that choice probably determined her career, for Herbert Hoover was a classmate in geology. They were married in 1899, and at once sailed on the first of their world-wide journeys. Mr. Hoover's work as mining engineer and economist took them to many countries of Europe and the Orient. As first lady of the land Mrs. Hoover took time from her duties as official hostess, to relieve President Hoover of many of the demands made upon him for public appearances. She welcomed delegations to the White House and christened ships and aircraft. With Mr. Hoover she translated Agricola's medieval Latin treatise on metallurgy, 'De Re Metallica.' Mrs. Hoover was born in Waterloo, Iowa, the daughter of Charles Delano Henry.

Eleanor Roosevelt

Lou Hoover

Anna Eleanor Roosevelt (born 1884). Her vigorous writings and radio talks made Mrs. Franklin D. Roosevelt one of the best-known women in America long before she entered the White House. The daughter of Elliott Roosevelt, younger brother of the late President Theodore Roosevelt, Eleanor was orphaned at an early age. She was educated in New York and abroad. In 1905 she married her distant cousin, Franklin. Her family was large—four sons and a daughter—and her duties as the wife of a political leader were exacting; yet she achieved a career of her own. Politics, social betterment, and education were her major interests, and in each of these fields she did notable work. To carry out a theory she had about establishing industries in agricultural counties to give men and boys interesting and profitable work for the winter she started a furniture shop on the Roosevelt estate. For women she started weaving and other handiwork. She put her educational theories to work by teaching in a private school of which she was vice-principal. The money she earned by writing magazine articles and by talking over the radio was devoted to public and private charities. Tireless in her ambition to raise the standards of child care and training and to better the conditions of women in industry, she found time to continue some of these activities even in the White House.

WHITMAN, MARCUS (1802–1847). The courage of Marcus Whitman and his wife, Narcissa Prentiss Whitman, stands high in the record of the pioneer settlers who toiled over the 2,200-mile Oregon Trail and helped to win the Oregon territory for the United States. (*See* Far West; Oregon.) Both Whitman and his wife were killed in their work as missionaries to the Indians. But their sturdy lives left a deep impress upon the region that now forms the states of Washington, Oregon, and Idaho.

Whitman was born at Rushville, N. Y. He was a descendant of John Whitman, who had come from Norfolk, England, in 1635, and settled at Bridgewater in Massachusetts. Marcus studied medicine at Fairfield, N. Y., and practised four years in Canada and four in Wheeler, N. Y. In 1835, the American Board of Commissioners for Foreign Missions accepted him as a medical missionary to the Indians of the Far West. He went west to the Green River, then returned east for recruits. He married, and with his wife and three other missionaries made the first trip by wagon to the Pacific Coast. He established a mission station in 1836 at Waiilatpu near the present site of Walla Walla, Washington.

New posts were built when other missionaries arrived. Dissensions arose, and the American Board decided to abandon a part of the work in which Whitman was interested. Hearing of this, Whitman risked his life on a winter trip east across the continent (1842–1843) and persuaded the mission board to reverse its decision. A historical controversy has long raged over the question whether Whitman also made this trip east to persuade the United States government not to cede Oregon to England. Whatever may be the facts in this controversy, there is no doubt that Whitman played a great part in winning the people of the East to an appreciation of the value of the lands beyond the Rocky Mountains.

On his return west, Whitman helped to guide a train of 200 covered wagons safely to the Columbia Valley—the first great wave in the tide of American migration to the Oregon territory. In 1847, Whitman, his wife, and twelve others were massacred by Indians at the Waiilatpu mission.

WHITMAN, WALT (1819–1892). Mid-Victorian standards declared Walt Whitman's poems formless, barbaric, and highly improper. Today, many consider Whitman the greatest American poet, who dwarfs his successors "as Pike's Peak towers above its foothills."

Born at West Hills, Long Island, May 31, 1819, Walt was the second son of six children. He could truly be called a typical American, for he was descended from English and Dutch colonists who had emigrated to America before 1700. With the exception of one clergyman, all his forebears were farmers, mechanics, and seafaring men. From his father he inherited slowness and patience; from his "perfect mother" his capacity for loving both people and Nature.

A wide experience prepared him for writing. After being office boy, printer, school teacher, and newspaper reporter, he rose to the editorship of the *Brooklyn Eagle*. A trip to New Orleans at 30 taught him the vastness of this new America, and gave him the desire to become the poet of democracy. He wished to express his vision of life as a joyous companionship of free individuals, each a hymn of praise to his Creator.

While Whitman's thoughts and plans were slowly maturing, he worked as a carpenter, helping his father build houses for working people in the outskirts of Brooklyn. Twelve poems, which he printed himself, composed the first edition of 'Leaves of Grass', the book which was to be a storm center for the remainder of his life. He sent copies as gifts to well-known literary men. Some, like Whittier, threw the book in the fire. Emerson, on the other hand, recognized the poet's intention of raising humanity's concept of the body, by portraying the body as the glorious instrument of divine spirit. Emerson's letter, praising the book as "the most extraordinary piece of wit and wisdom yet contributed to American literature," was printed in the enlarged edition of the poems in 1856. This brought down upon Emerson a storm of adverse criticism.

During the Civil War, Whitman nursed the wounded, friend and foe alike, in the hospitals in Washington. A pamphlet, written years later in his defense, shows us the real character, the kindness, and the great heart of "the good gray poet" as his friends and the wounded soldiers knew him. Out of this harrowing experience, Whitman developed a deepened concept of a unified America and a unified humanity. This he expressed in a book of poems called 'Drum Taps'. Among the best known are his laments for the death of Lincoln, called 'O Captain! My Captain!' and 'When Lilacs Last in the Dooryard Bloom'd'.

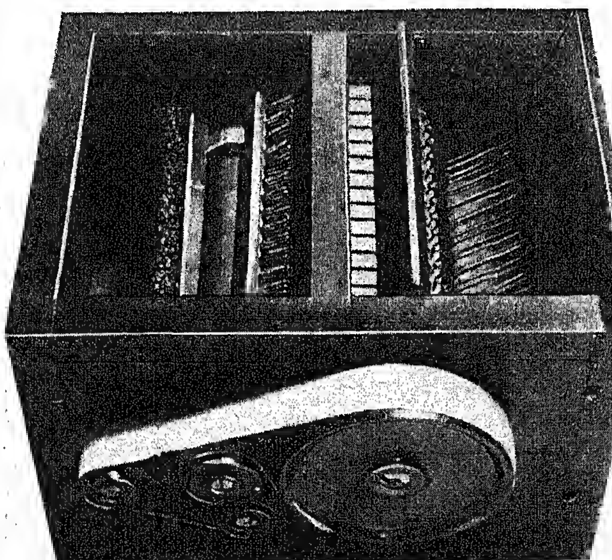
Whitman had given too much of even his giant strength to the sick, and had stayed too long in the stifling, malarial atmosphere of the hospitals. Though the results were long delayed, months of illness were followed, in 1873, by the first of a series of paralytic attacks, which made him an invalid for the last 19 years of his life. He died March 26, 1892.

More than almost any other author, Whitman managed to express the full force of his personality in his writings. No other American poet has achieved comparable exaltation of thought and emotion, or an equal variety of form and rhythm. He has been called the father of free verse and of realism in American literature. But he would have disowned the so-called realism which pictures the ugly only to teach a pessimistic view of life; his realism was a picture of possibilities, to teach the joyous hope of the future.

Lincoln said of Whitman, "Well, he looks like a Man!" Many writers of distinction in Europe and America have acknowledged the great debt their work owes to him. His books are read in translation in many languages.

Whitman's books of poems include, besides 'Leaves of Grass' and 'Drum Taps', 'Calamus', 'November Boughs', 'Sands at Seventy', and 'Good-Bye, My Fancy'. His prose works include 'Democratic Vistas', 'Specimen Days and Collect', 'The Wound Dresser' (letters), and 'Diary in Canada'. He lived to edit a complete collection of his works, with critical estimates and biographical notes. This was first published in 1892.

MODEL OF THE FIRST COTTON GIN



In this machine, invented by Eli Whitney, raw cotton was fed into the hopper at the right. There it dropped down against that steel screen or grid. The hooked teeth on the revolving drum passed between the slots of the grid, seizing the fibers and pulling them through while the seeds fell into another compartment. The revolving brushes at the left removed the cotton from the drum teeth.

WHITNEY, ELI (1765–1825). It was a son of Massachusetts, the stronghold of freedom, who made cotton-raising profitable and thus innocently helped to fasten slavery on the South. His name was Eli Whitney.

Of Puritan ancestry, he was born at Westboro, Mass., Dec. 8, 1765—a month later than Robert Fulton. His

home was a bare farmhouse, and his father was a stern man who brought up his children on hard work. Eli's mechanical skill and ingenuity gave him full use of the workshop, the pride of every New England farmer in those days. At 12, he made a violin; and during the Revolutionary War he beat out nails on a home-made forge. Money saved from nail making and school teaching sent him through Yale College; but earning and saving had been a long hard task, and he was 27 when he was graduated. He went as tuter to a family near Savannah, Ga., but found the job already taken. He then began the study of law and did repair work.

In the South at that time a great problem stood in the way of producing enough cotton to meet the demands of England's newly invented spinning and weaving machines. To separate cotton fiber from the seeds by hand took too long. Impressed with Whitney's ability, his southern friends urged him to invent a machine to do this work.

He had never even seen raw cotton, but he got the idea at once that *fingers* of some sort were needed. A shop was fitted up for him, and he set to work. The gin which he invented and finished after eight months' labor (1793) was based on simple principles, but it was so effective as to produce immediate and tremendous results in the South. Within seven years, by 1800, cotton production had increased from about 3,000 bales a year to 73,000 bales a year.

Whitney did not profit financially from his invention. His machine was stolen and copied; his patent was infringed; his factory was set on fire; and lawsuits consumed his earnings. Through all this, Whitney remained undefeated and without bitterness.

In 1798, when he was deep in debt, he obtained a federal contract for 10,000 muskets. Backed by his friends, he built a factory near New Haven, Conn., and designed a new gun and machinery to make it. Up to that time, guns had been handmade, no two exactly alike. But Whitney's machine made parts exactly alike (interchangeable or standardized parts), so that each would fit any of the guns turned out in the factory. He also established division of labor, each man specializing on making one part of the gun. The final step was merely to assemble the parts. Whitney thus became the father of mass production and of the assembly line, so important to industry today. As the factory prospered, Whitneyville grew up around it. In 1817 Whitney was married. A few years later he contracted a lingering illness, and died Jan. 8, 1825.

WHITNEY, MOUNT. The loftiest summit in the United States outside of Alaska is Mount Whitney, a peak of the Sierra Nevada Range in southeastern California. It towers 14,495 feet above sea-level and its precipitous eastern slope rises nearly 11,000 feet above Owens Valley. A most interesting fact is that Death Valley, the lowest depression on the continent, lies less than 100 miles from this giant mountain. As you climb you will notice that the sides of the mountain are scored and polished here and there by the ancient glaciers that flowed down to the present valleys of the Kern and Owens rivers as tributaries to greater ice flows. Today, however, the mountain has no glaciers, only small and shallow patches of lasting snow and ice on the northern slopes. Mount Whitney was named in honor of an American geologist, Josiah Dwight Whitney, of Harvard University. It has been ascended several times.

WHITTIER, JOHN GREENLEAF (1807–1892). One has only to read Whittier's 'Barefoot Boy' to picture for himself the happy, healthy, but hard-working childhood of "the Quaker Poet" on the small farm at Haverhill, Mass., where he was born. And in his long descriptive poem 'Snowbound' he gave a charming account of the quiet home joys, outdoor sports, and the hardships, sturdily overcome or cheerfully endured, of a bleak winter in the valley of the Merrimack. Everyone on the stony hill farms of that region could by industry and economy be sure of the plain comforts of living, but there was never much money. So Whittier, a good and thoughtful boy, who wanted to do and say helpful things for a larger world when he grew up, taught country schools and cobbled the neighbors' shoes to earn enough to pay for two years' instruction in Haverhill Academy.

A copy of Burns' poems loaned him by his teacher when Whittier was 15 awoke in him a desire to write verse. His first published poem, written at the age of 19, appeared in a periodical edited by William Lloyd Garrison. It led to a lifelong friendship with this bold and gifted leader of the anti-slavery movement. To this unpopular cause Whittier devoted his own talents and became its recognized poet, as early as 1832. Nor should it be forgotten that Whittier's letters show that he helped every good cause by his shrewd political advice, for this New England Quaker, had he not chosen to stand with the anti-slavery group, might have had a place in Congress with his distant relative Daniel Webster. While engaged in newspaper work in Boston, Hartford, and Philadelphia he wrote anti-slavery tracts and pamphlets, and in verse of quiet strength and wide influence he celebrated or deplored the chief dramatic events of that political conflict. He was not to be silenced, for when the printing office of *The Pennsylvania Freeman* was destroyed by a mob, his reply to violence was the publication of his 'Voices of Freedom'.

Whittier contributed some fine patriotic poems to the cause of Union during the Civil War and when the war was won he wrote his 'Laus Deo' (Praise God). Amesbury, near Haverhill, was his home after 1836 and his house there became one of the literary shrines of America. There he wrote hymns that are sung in the churches of several denominations. In narrative poems and ballads he preserved the romantic legends and stirring history of the seaboard colonies and he described the rural scenes and social life of the New England of his boyhood days as no other American poet has done.

Whittier's verse is characterized by extreme simplicity of thought and style, and by what Lowell

calls a "genial piety." It is unequal in merit, sometimes faulty in rhyme, and he has a tendency to moralize. But as one sympathetic critic has said, "this perfectly expresses the poet himself, his character, and point of view." First of all a reformer, Whittier used poetry as consciously and candidly for moral ends as a preacher uses the sermon. And as clearly as though from the pulpit, he preached the beauty of holiness, the pure joys of home life, the duty of laboring for humanity and justice, the glory of sacrificial patriotism, and the consolation of faith. His poetic gift was more limited, but not inferior in quality or in influence over his day, to Longfellow's.

Whittier's chief poems, in the order of publication, are: 'Legends of New England'; 'Ballads'; 'Voices of Freedom'; 'In War Time'; 'National Lyrics'; 'Home Ballads'; 'Snow-bound'; 'The Tent on the Beach'; 'Among the Hills'; 'Ballads of New England'. His favorite short poems are: 'The Barefoot Boy'; 'Barbara Frietchie'; 'Maud Muller'; and 'In Schooldays'.

WICHITA, KAN. Cow punchers drove steers up from Texas along the dusty Chisholm trail to Wichita in the 70's and 80's and loaded them on open-sided cars bound for the stockyards in Kansas City and Chicago. The cowboy ballad sings:

Yessir, trailed 'em up to Wichita,
'Cross the Kansas line . . .
Turned most of 'em to soldiers, some to Injuns too,
Beef wasn't so high then—*now* I'm tellin' *you*.

The former rough "cow town" is now the second largest city of Kansas. Situated on a tableland in south central Kansas, it spreads on both sides of the junction of the Arkansas River and the Little Arkansas. Tall office buildings and stores loom in a white, modern sky line, in picturesque contrast to the near-by oil derricks and rolling seas of winter wheat.

It was from the rich resources of the prairie that Wichita built its industries. The city ranks high in flour milling, and is the chief market for the nation's broom-corn crop. Dairy products are important, and poultry and corn-fed Kansas beef are processed in its packing houses. Petroleum and natural gas from the neighboring Mid-Continent field attracted oil refineries and manufacturing industries, which produce farm implements, oil-well supplies, brooms, furniture, and airplanes. Railroads, highways, and a transcontinental air route focus on Wichita, helping to make it the trade and banking center for southern Kansas and northern Oklahoma.

Among the city's educational facilities are the Art Museum, Friends University, and Wichita Municipal University. Founded in 1870, the city was named for the Wichita Indians of the region. In 1917 it adopted the council-manager type of government. Population (1940 census), 114,966.

WIGHT, ISLE OF. Golfers find rare sport on the rolling fairways of the Isle of Wight, and yachtsmen throng there for the Cowes regatta, the most famous of British boat races. Nature enthusiasts love the fresh beauty of the surf pounding against sheer chalk cliffs and of downs covered with bracken, heather, and grazing sheep. Tourists visit ivy-covered Farringford, for 40 years the home of Tennyson; or Shanklin, where Keats wrote; or the grave of Swinburne at New St. Boniface. Geologists come from afar to study the chalk cliffs, pinnacles, and towers, and the great caves and other formations cut in the hills by the pounding seas.

The Isle of Wight, in the English channel off Portsmouth, is 23 miles east to west and 14 miles north to south, with an area of 147 square miles. A marshy isthmus joins the two parts of this English playground, which has a mild healthful climate given by the sea winds. Newport is the chief town, and Cowes, home of the Royal Yacht Squadron, is the main port. Fashionable resorts are at Cowes, Ryde, Sandown, Shanklin, and Ventnor. The island, which has a population of about 90,000 is part of Hampshire. It is represented in Parliament by one member.

Vespasian conquered the island for the Roman Empire in 43 A.D. Danish pirates repeatedly invaded it, and the French attacked it several times from the 14th to the 16th centuries and laid waste both Yarmouth and Newport. The coast of the island is now strongly fortified.

A tragic drama was enacted in Carisbrooke Castle in 1647–50. Charles I, with two of his children, was imprisoned there for 14 months, and the little princess Elizabeth died there.

Queen Victoria retired to Osborne House near Cowes in her last days, and was living there at the time of her death. Her son, King Edward VII, gave the house to the British nation.

WILKES-BARRE (*wĭlks'băr-ĭ*), **PA.** Coal underlies the very streets of Wilkes-Barre, and coal is the heart of its varied industries. The snugly built city is on the east bank of the Susquehanna River in Wyoming Valley, center of the anthracite region. This fuel supply drew heavy manufacturing plants to Wilkes-Barre. Their products include iron and steel, wire, locomotives, and machinery. Economical labor, afforded by the wives and families of miners, attracted silk and rayon mills, and the manufacture of tobacco products. Wilkes-Barre is the distribution center for neighboring mining towns, and a starting point for tours of the scenic Wyoming Valley. This city is of New England heritage, for it was settled in 1769 by John Durkee and others from Connecticut. They named it for John Wilkes and Col. Isaac Barre, members of parliament and friends of the colonies. It was burned by victorious British and Indians after the battle of Wyoming in 1778. Again in 1784 it was burned during the Connecticut-Pennsylvania dispute over ownership of Wyoming Valley. It became a city in 1871, and now has a commission form of government. Population (1940 census), 86,236.

WILKINS, SIR (GEORGE) HUBERT (born 1888). One of the most memorable feats of polar exploration was Hubert Wilkins' 2,200-mile flight in 1928 from Point Barrow, Alaska, to Spitsbergen, over a vast hitherto unknown area of the Arctic Ocean. His pilot was Lieut. Carl Ben Eielson. Later that same year Wilkins

and Eielson flew over part of Antarctica, studying the region about Graham Land and the vicinity of Charcot Island. Wilkins was convinced that a chain of meteorological stations in the Antarctic would help greatly in forecasting weather in the southern hemisphere, and he spent 1929–30 studying sites for such stations. In 1931 he tried to study the floor of the Arctic Ocean by going under the ice in an old American submarine, which he named the *Nautilus;* but the ship failed him before he made much progress.

During the Balkan wars, Wilkins took the first pictures of actual fighting ever shown in motion picture theaters, and he won decorations for bravery during the World War. In 1913–17, he was moving-picture photographer with the Stefansson Arctic expedition. He led the British Imperial Antarctic expedition in 1920–21, and served as naturalist on the last Shackleton Antarctic expedition in 1921–22. The British Museum sent him to explore little known parts of Australia in 1923–25.

Wilkins was born at Mount Bryan East, South Australia, and graduated from the Adelaide School of Mines. He was knighted by King George after his Arctic flight. He wrote vividly of his adventures in 'Undiscovered Australia' and 'Flying the Arctic'.

WILL, IN LAW. A man's word carries across the grave in his "last will and testament," directing who shall profit by the dollars and the lands he has left. Wills often show human quirks. Shakespeare willed his wife only his "second-best bed with the furniture." Jonathan Swift named all the friends who were to get his beaver hats. Some wills are short, and others run to hundreds or thousands of words, like those of Florence Nightingale and Napoleon. A notable example of a simple, brief will was that left in 1921 by Chief Justice Edward D. White of the United States Supreme Court. It disposed of his estate in 51 words, plus his signature, thus:

> This is my last will. I give, bequeath and devise to my wife, Letitia M. White, in complete and perfect ownership, all my rights and property of every kind and nature, whether real, personal or mixed, wherever situated, appointing her executrix of my estate without bond and giving her seisin thereof.—EDWARD D. WHITE

Two of every three Americans owning a fair amount of property are said to die without wills (*intestate*), and the state has to step in and decide how the estate or property is to be divided. A man may draw up his own will, but it is safer to employ an experienced lawyer so that the document may be legally perfect. A codicil is an addition to a will altering or adding to the provisions previously stated. A will must be signed at the end by the *testator* (maker of the will) and by two witnesses—three in some states. A *beneficiary*, or *heir*, under a will who acts as a witness to that will forfeits his right to any part of the estate. The unconventional *holograph* will—unwitnessed, but written in the will maker's handwriting—is recognized in some states. The *nuncupative* will—uttered by a soldier or sailor facing death, or by a person on his death-bed, and preserved only in the memory of the witnesses—is generally accepted. In the United States the maker of a will has, with a few exceptions, the right to distribute his property exactly as he pleases, though some states keep him from willing everything away from wife and children. Less than one per cent of wills are ever successfully contested or "broken." The *executor* is the person or trust company named by the maker of a will to carry out the provisions of his will. An executor serves only until the estate has been closed legally, and the proceeds turned over to the beneficiaries or trustees. A *trustee* holds or manages all or part of an estate until such time as the will directs that it be distributed. After the death of the testator a will must be *probated*, or legally proved sound, usually in a special court. Before an estate is divided in the United States and certain other countries an inheritance tax is paid (*see* Taxation).

WILL, IN PSYCHOLOGY. We all feel that we have the conscious power to choose between alternatives. Whenever we make a deliberate decision to perform an action, to keep a resolution, to resist desires or impulses, we describe it as an act of "the will."

Psychologists differ in defining and explaining this phase of our mental life. All agree that there are involuntary actions in which the will plays no part. The simplest involuntary action is one directed wholly by external stimuli. Thus, we touch a hot iron, and automatically draw back the hand (*see* Reflexes). Another involuntary action may be directed by instinct. We stumble, and immediately, without reasoning, shift our weight to regain balance. Still another may be due to habit (*see* Habit). The experienced driver of an automobile, when danger appears ahead, finds his foot shifting from accelerator to brake almost without his knowledge.

The voluntary act differs from this type mainly because there is conscious knowledge of an end to be attained. A man may idly take his watch out of his pocket, and toy with it, not being conscious that he is doing so—a purely involuntary act. Or he may want to know the time, and deliberately reach for the watch to discern the hour—a voluntary act.

Degrees of Voluntary Actions

There are also various degrees of voluntary actions. At one extreme may be the so-called impulsive act, that is, an act that might not be carried out during mature reflection, but is performed hastily under the influence of a sudden emotion or exceptional incentive. At the other extreme are the deliberate, or strictly voluntary actions, in which the individual with full knowledge of what he is doing, initiates and carries through a train of action.

An act of this sort may even repress or inhibit involuntary actions. For instance, instead of drawing your hand away when touching a red-hot iron, you may deliberately hold it there to cauterize a snake bite. The exercise of inhibition or self-control is the highest type of willed action.

In the older psychology, the will was looked upon as one of the three faculties of the mind, the two

others being intellect or thought, and emotion or feeling. According to this view the will is guided by the intellect, and has the power to decide freely what actions shall be taken, and what actions avoided.

Modern psychologists tend to look upon human behavior as the outcome of stimuli which have been introduced into the life of the individual. Human conduct, they say, in common with all the other things with which science deals, is subject to law and necessity. Our acts, therefore, are always the result of past experiences and native reactions, even though we experience a feeling of freedom at the moment the decision was made.

Nevertheless, a distinction between mere impulse and wilful choice has always been recognized as a basis of civil and moral responsibility. Training in making careful decisions and the exercise of self-control are likewise regarded as important functions of education.

WILLARD, Frances Elizabeth (1839–1898). This gentle Christian reformer and practical philanthropist is one of the best loved and most widely celebrated of all American women. To her devotion and trained ability is due the phenomenal growth of the Woman's Christian Temperance Union and very largely of the prohibition movement. Born at Churchville, near Rochester, N.Y., on Sept. 28, 1839, she was fortunate in having parents of rare moral and intellectual character. To give their older children educational advantages, they removed to the college town of Oberlin, Ohio. When Frances was seven they settled on a farm near Janesville, Wis. At 17 Frances was sent to Milwaukee to school and afterward to the Woman's College at Evanston, near Chicago. For the next 40 years this was her home. She became dean of her own alma mater, resigning in 1874 when the college was incorporated with Northwestern University.

Turning from the most attractive financial offers, she entered the temperance movement, joining a little band of women without money or experience in Chicago. Her decision was talked about, for she was a noted woman of proved leadership in the educational world. To the W.C.T.U. she gave immediate impetus by the conversion of hundreds of men from drunkards to useful citizens. She consented to accept a salary sufficient to provide for her mother and herself and, finally, the modest gift of Rest Cottage, the home in Evanston, but her earnings as lecturer and writer she turned into the W.C.T.U. fund. In 1879 Miss Willard was elected president of the national W.C.T.U.—an office she filled for 20 years. She insisted upon the adoption of a demand for woman suffrage by the organization, on the ground that the ballot was the most effectual weapon to defend the home, and she made her organization a unit when it used its influence for prohibition.

After 1880 Miss Willard was almost continually engaged in travel and in organizing states and foreign countries, and at the time of her death 35 nations had lined up under the white ribbon. In addition to this work she wrote books, established and helped edit *The Union Signal,* inspired the Chicago organization to build the Woman's Temple at a cost of $1,000,000, to establish the W.C.T.U. home for working women, a publication office, and national headquarters. All of this grew in 25 years from a beginning so small that at first Miss Willard could not always get money for carfare and lunches, while the national W.C.T.U. had a total income of only $1,200.

A scholarly, refined, reserved woman, Miss Willard was aggressive only in act, never in manner. A statue of her has been placed in Statuary Hall, in the Capitol at Washington, among those of presidents, statesmen, and military heroes.

The FIRST *and the* LAST *of* GERMANY'S KAISERS

How William I and His Great Minister Bismarck Created the German Empire, and How His Grandson William II, in His Craving for More Power, Plunged the World into War and Lost His Throne

WILLIAM, German Emperors. Two kings of Prussia of this name, members of the house of Hohenzollern, have also borne the title "German Emperor" as heads of the modern German Empire.

William I (1797–1888), the first German emperor, was born when his country was a cipher in European politics, and spent his youth in the days when Napoleon had overrun Prussia and all Europe. It was these disasters that contributed much to the early death of his mother, the beautiful Queen Louise, in 1810. As second son he was not expected to come to the throne and devoted himself entirely to the army. In the democratic revolutionary year of 1848 he was obliged to leave Berlin, where he was unpopular as "Prince Cartridge." The next year he commanded the Prussian troops that defeated the revolutionary army under Franz Sigel, and drove Sigel and Carl Schurz as refugees to America.

His elder brother, King Frederick William IV, was childless, and in his later years insane. As regent and then as king of Prussia (after 1861) William I bent every energy to the reform and building of the Prussian army. It was his one significant independent act. It brought him into conflict with the Prussian legislature and forced him to call Bismarck as minister-president. After 1862 the history of William's reign is the history of his support of Bismarck's measures and policies—reluctantly at first but in the end unwaveringly.

He personally preferred to remain simply king of Prussia, but Bismarck and the Crown Prince persuaded him to accept the title of German Emperor in 1871.

Confidence in his simple, direct, and generally upright character was an asset to the new empire and also to the more unscrupulous Bismarck. As the "Old Emperor" he lived on to the age of 91. His bumptious grandson William II, in an effort to belittle Bismarck's work and attribute all credit to the Hohenzollerns, always called him "William the Great" and erected innumerable statues to his memory.

WILLIAM II (1859–1941) came to the throne after the brief reign of his father, Frederick III (March to June 1888).

Since the days of the great Napoleon no other ruler had been so exalted or had suffered so terrible a downfall as this third and last German emperor. Indeed the downfall of the Kaiser was greater in one way than that of Napoleon, for the latter had learned by early experience the uncertainty of fate, while the Kaiser believed himself to be sovereign by divine right, with a mission to carry German "Kultur" to the farthest corners of the earth.

WILLIAM II
Last Emperor of Germany

The son of the popular Crown Prince Frederick and of the eldest daughter of Queen Victoria of England, he showed toward both parents anything but the love and respect due from a son. As a young man of 29—well educated in all the arts, versatile, and self-confident to an extraordinary degree—William II had come to the throne (June 1888) with the determination to rule as well as reign. So one of his earliest acts as emperor and Prussian king was to drop overboard the old pilot Bismarck, who had made the German Empire and had guided its destinies during the reign of his grandfather, William I, and the hundred days of his father's death-bed rule.

From birth William II's left arm was shriveled and deformed, yet he constantly displayed a feverish energy of action as well as of mind—engaging in spectacular visits to other lands, deer and wild-boar hunts, army maneuvers, and the like. He prided himself on being scientist, dramatist, painter, and theologian, and never hesitated to set his opinion against that of specialists in these lines. He was immensely proud of his painting 'The Yellow Peril', showing a vast Asiatic dragon creeping in upon European civilization.

From the first William placed his reliance on his army. Amid the constructive work of statesmen, financiers, and captains of industry—which raised Germany almost at a bound from the position of one of the backward countries of Europe to one of the most progressive—was to be heard in crisis after crisis of European affairs the ominous saber-rattling of this Prussian "War Lord." "It is the soldier and the army," he once declared, "and not the majorities and parliamentary decisions, that have forged the German Empire. It is on the army that my confidence rests."

But to win for Germany the "place in the sun" that he claimed, he first needed a navy as well as an army. With the declaration that "Germany's future is upon the waters," he turned with characteristic energy, after 1898, to the development of the German fleet. In spite of his protestations of friendship, England viewed this action with alarm, for the island character of that country made command of the sea a necessity to her. That alarm was at last seen to be justified when Europe's tensions exploded in the first World War, and England's still superior sea power proved a decisive factor in bringing about the defeat of Germany and her allies. (*See* World War of 1914–1918.)

Finally on Nov. 9, 1918, when Germany itself had risen in revolution against him, William II sought safety in flight into neutral Holland. There he abdicated his double crowns of Prussia and the German Empire. The Allies sought to put him on trial but Holland refused under existing international law to give him up.

A cartoon published by the German journal *Simplicissimus* fittingly characterized the close of his reign. It showed a desolate "No-Man's-Land" stretching away under gray skies to a remote horizon. In the far distance was the departing figure of William II seeking refuge in Holland. In the foreground stood a tragic group of widows, orphans, and war cripples; and underneath were these biting words: "We shed no tears for him, for he has left us no tears to shed."

Henceforward the ex-Kaiser lived a life of seclusion, first at Amerongen and later at Doorn, near Utrecht. The Kaiserin Augusta Victoria died in 1921, and the following year he married Princess Hermine of Reuss. Although various movements were set on foot for his restoration to the throne, he always disavowed any connection with them.

Following the revolution in Russia in 1917 there was published a series of remarkable letters from the Kaiser to Czar Nicholas II—signed "Willy" and addressed to "Nicky"— in which was first fully revealed the character of William II's intrigues for some years before the war. Other revelations from German archives at Potsdam (near Berlin) showed how the Kaiser backed up Austria in the demands which brought on the World War. "Serbia," wrote he, "is a pack of brigands who must be brought to book for their crimes." When England first let it be known that she would not stand aside and let France be crushed, the Kaiser in his fury wrote of Lord Grey, the British foreign minister: "Low hound! Responsibility for peace rests upon England alone and no longer upon us." But William II in those momentous later years was far more a tool in the hands of the powerful military and naval cliques of Germany than the real ruler of her destinies.

The Four WILLIAMS *of* ENGLAND

The Duke of Normandy who Conquered the Island and Knit It Together by His Stern but Just Rule—The Hated King Rufus—The Able William of Orange, and the Bluff Old Sailor King, William IV

WILLIAM, KINGS OF ENGLAND. Only four kings of England have borne this name, which was introduced with the Norman Conquest.

WILLIAM I, THE CONQUEROR, who ruled England from 1066 to 1087, was the sixth Duke of Normandy in descent from Rolf, or Rollo, the founder, and had many qualities of his Viking ancestor. He was only seven years of age when he inherited the duchy, under the guidance of faithful and able guardians, and was forced to struggle against his rebellious barons. At 24 he had not only established his authority, but had made himself the mightiest lord in France by other conquests.

But William's ambitions went further. Across the Channel reigned his father's cousin, the childless Edward the Confessor, to whom William paid a visit and apparently obtained that king's promise that he should succeed to the throne of England. So when Edward died in 1066 William claimed the throne, despite the fact that Earl Harold was chosen king by the English. He had other pretexts to strengthen his claims. He had extorted an oath from Harold to support his succession when Harold was shipwrecked on the coast of Normandy; he had married Matilda, a Flemish princess descended from the old Anglo-Saxon line of kings; and he had obtained the blessing of the pope upon his enterprise.

WILLIAM I
Norman Conqueror of England

Landing with an army of Norman adventurers and soldiers of fortune from all over Europe, William defeated the forces of the English king in the battle of Hastings (1066), leaving his hapless rival dead on the field. Tradition has preserved a characteristic anecdote. As William landed he is said to have stumbled and fallen on the beach—an unlucky omen. With ready wit he clutched a handful of sand and holding it aloft said: "By the splendor of God, I have taken possession of England!"

After Hastings the men of London went out to meet the conqueror and hailed him as king. He was crowned on Christmas Day, and became the founder of a new line of English kings. The blood of this Norman conqueror flows in the veins of every king and queen who has sat on the throne of England since his day.

Five years of warfare were needed to subdue the turbulent earls of the north and west. King William showed himself a stern and pitiless master, carrying waste and ruin into wide areas and erecting castles to keep the people in subjection. He seized the lands of those who had fought against him and gave them to his followers, or allowed their holders to take them back only on payment of heavy fines. He thus established the feudal principle that every foot of the soil was the property of the Crown, and granted it to his vassals only on condition of an oath of fealty and the promise to serve him with money and men. William further strengthened the power of the Crown against the great lords by demanding an oath of allegiance from all freemen, which took precedence of the fealty they owed their lords.

His wise policy of retaining the old Anglo-Saxon laws, courts, and customs, with only a few innovations, confirmed the loyalty of the mass of the people. Thus the principle of local self-government, which lies at the root of the political system of the English-speaking peoples, was preserved and strengthened. At the same time William taught his people of England the advantages of a strong central government, powerful enough to control the feudal lords and secure justice for all.

Among the new measures instituted by the conqueror were the reservation of great tracts of forest for the king's hunting, and the compilation of a great census known as the Domesday Book. "So very narrowly did he cause the survey to be made," complains the old Anglo-Saxon chronicle, "that there was not a single rood of land, nor an ox, or a cow, or a pig passed by, and that was not set down in the accounts."

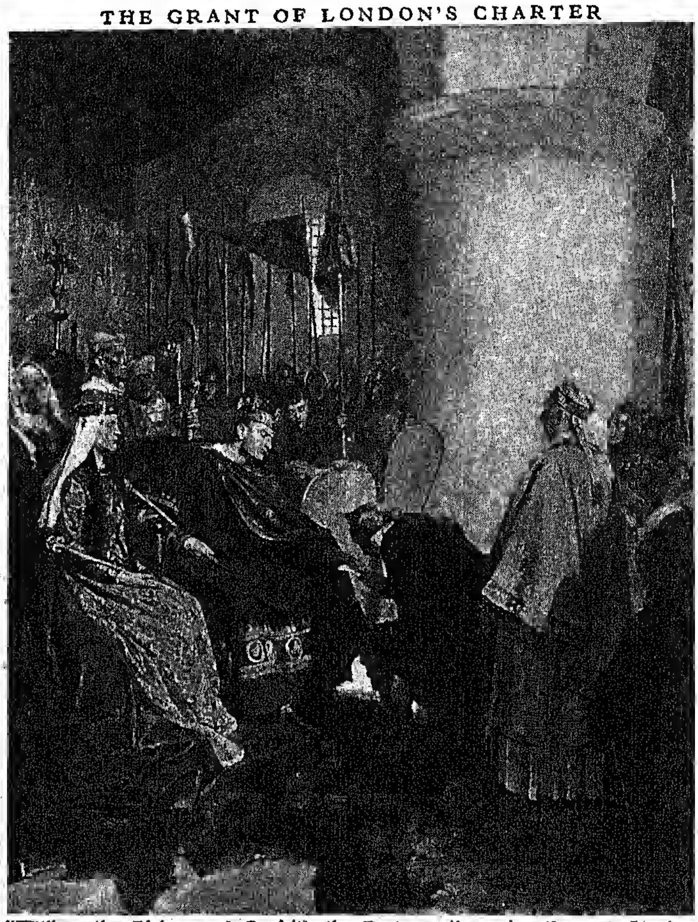
William met his death in 1087, from an internal injury received while warring with Philip of France. He was a man of great stature and weight, with a tremendous voice. The old chronicler tells us that he was "mild to those good men who loved God, but severe beyond measure to those who withstood his will." Though he was despotic and grasping, he was "a very wise and great man." Such was the good order he established that, according to the quaint old historian of his time, "any man, who was himself aught, might travel over the kingdom with a bosom of gold unmolested, and no man durst kill another, however great the injury he might have received from him."

Before his death William divided his lands, giving Normandy to his eldest son Robert, and England to William Rufus, his next son. To his youngest son

Henry he left 5,000 pounds of silver, saying—so the story goes—that in due time Henry would get all that his father had. (*See* Feudalism; Harold; Hastings, Battle of; Normandy.)

WILLIAM II, who was called Rufus or "Red," ruled from 1087 to 1100. "He was hated by almost all his people," says the old chronicler, "and abhorred by God." He "openly mocked at God and the saints" and "He every morning got up a worse man than he lay down and every evening lay down a worse man than he got up." With fair promises he prevailed on the people to help him put down the Norman lords, who sought to put his elder brother Robert on the throne, and after gaining the victory with their aid, he turned on his subjects and oppressed them grievously. He was capricious, ungrateful, extortionate, wasteful, and vicious. The only good thing that can be said for him is that he kept down the barons with a strong hand and rigidly enforced peace in the land.

THE GRANT OF LONDON'S CHARTER



"William the Bishop and Gosfrith the Portreeve" receive the new London charter from the Conqueror. The charter was granted soon after the battle of Hastings and the acceptance of William's rule by the people of the city. At King William's right sits his wife, the Flemish princess Matilda. This picture by *J. Seymour Lucas is in the Royal Exchange of London.*

He called down the wrath of the monks in particular because of his shameless practice of selling church offices or keeping them unoccupied that he might seize their revenue for himself. Once when he fell sick and thought that he was dying, William vowed to turn from his vile ways and to fill the archbishopric of Canterbury, which he had kept vacant for four years. His choice fell on Anselm, abbot of Bec in Normandy, the greatest theologian of the age. A gentle and upright man, so tender that he is said to have saved the life of a hunted hare, Anselm accepted this high office with the greatest reluctance, protesting that it was like "seeking to yoke a young unbroken bull to a weak old sheep." His forebodings proved only too true, for when William recovered he returned to his old ways. Contrary to church rules he insisted upon conferring the symbols of office upon the archbishop himself, instead of allowing it to be done by the pope. On this question of lay investiture of the clergy, as the consecration of priests by civil rulers is called, Anselm took a determined stand against the king, and there was a never-ending series of disputes until four years later when, wearied of wrangling, he went to Rome and William again seized the property of the archbishopric.

In 1096 William received Normandy as a pledge from his elder brother Robert, who mortgaged his duchy for funds to join the First Crusade. War against the Scotch, the Welsh, and rebellious barons checkered his reign. He came to a fitting end, slain by an arrow in his own New Forest which his father had set aside for his favorite sport of hunting. Whether the shooting was by accident or intention no one knows. No one cared enough for him to do his body honor, and he was hastily buried without religious rites at Winchester. He was succeeded by his younger brother as Henry I.

WILLIAM III, who ruled England from 1689 to 1702, came to the throne by the revolution of 1688 which cast out James II. He was the great-grandson of William the Silent, Prince of Orange, who had won for the Dutch Netherlands their independence from Spain, and since 1672 he himself was "stadholder" and captain-general of the United Provinces. But he was also the son of one English princess, daughter of Charles I, and the husband of another, Mary the eldest daughter of King James II.

Since William was the chief defender of the Protestant interests on the Continent, and Mary was regarded by most as the real heir to the English kingdom, what was more natural than that English nobles and bishops should turn to him, with an

invitation to save them from the tyranny and attempted Catholic restoration of James II? He had but to land (Nov. 5, 1688) with an expedition of 14,000 men, and almost the whole of England and Scotland rallied to his support. James II conveniently ran away, and William and Mary were crowned joint sovereigns. A Bill of Rights passed by Parliament ratified the changes. Ireland, however, did not submit until James was defeated in the battle of the Boyne; and throughout his reign plots were hatched against his life and rule by followers of the exiled Stuarts. Although William was never popular with his English subjects on account of the fact that he was a foreigner and lacked geniality, his reign was one of great progress in real liberty and constitutional government, and he ranks in the judgment of historians as one of the ablest of Britain's kings.

William's chief interest, however, was always on the Continent. He had come to power in the Netherlands at a time when Louis XIV was embarking on his plans for "universal monarchy," and he had already (1672–78) won fame for his skill in generalship and in building up alliances to resist French aggression. He chiefly valued the English crown for the added resources it brought him in this life-long duel. Twenty times William barely escaped being crushed. But he "represented the ideas of the future—free thought in religion, popular sovereignty in politics," and these principles sustained and inspired him. After another eight years of war (1689–97), Louis XIV made a peace at Ryswick (1697) which left him only slight gains, and bound him to cease his support of the Stuart pretender to the English throne. The "peace", however, proved to be but a breathing space.

Five years later, as the last and greatest of the wars with Louis XIV was about to break out, William III died from the effects of a chill and a fall from a horse. Queen Mary had died several years before. Since they had no children the throne passed to her sister, the Princess Anne (*see* Anne, Queen of England; Bill of Rights; Marlborough, First Duke of).

William IV, the "Sailor Prince"

WILLIAM IV, who reigned for only seven years (1830–1837), was known before his accession as the Duke of Clarence. He was the third son of George III, and was born in 1765. He was a sailor prince, having been sent to sea at the age of 14. A Spanish admiral, seeing him doing duty as a midshipman, exclaimed: "Well does Great Britain merit the empire of the sea, when the humblest stations in her navy are supported by princes of the blood!"

William was in his 65th year when he became king. He was bluff and hearty in manner, as became a sailor, and was liberal in his politics. The greatest measure of his reign was the Parliamentary Reform Act of 1832. This opened the way to a flood of other liberal measures, which continued to follow one another through Parliament long after William IV had passed from the scene and his niece Victoria had come to the English throne. (*See* Parliament; Russell, John.)

WILLIAM THE SILENT, PRINCE OF ORANGE (1533–1584). When Charles V with impressive ceremonies laid down his office as ruler of Spain and the Netherlands (1555), he leaned on the arm of a tall young man, William, Prince of Orange. On the other side of him stood his sickly ill-shapen son, Philip II, who was taking over the duties his father was laying down. In a few years these two young men were to be bitter enemies, and William of Orange was to be the leader of the Dutch armies in their struggles for religious and political liberty (*see* Philip, Kings of Spain).

At the time of Charles' abdication William was 22 years old. At the age of 11 he had succeeded to the little principality of Orange in southern France and to possessions in the Netherlands. From early youth he had been brought up at the court of the emperor, who had given him many important duties and sent him on diplomatic missions. Thus he gained the experience and wisdom which made him the greatest statesman of his day.

On one mission to France, William won his name "the Silent" from the good sense with which he held his tongue when the king of France incautiously spoke to him of Spain's plan for rooting Protestantism out of the Netherlands. "From that hour," wrote William 20 years later, "I resolved with my whole soul to do my best to drive this Spanish vermin out of the land."

And for this reason when the bloody persecutions of Philip's general, the Duke of Alva, drove the Dutch to armed revolt, William put himself at the head of the movement. By birth a Lutheran German, brought up as a Catholic, he accepted finally the Protestant faith of his Dutch compatriots. But his varied experience taught him the necessity and wisdom of religious tolerance on the part of a ruler. He was thus ahead of his time and in sharp contrast with the bigoted Philip II.

At first the struggle was a losing fight. William was defeated and was obliged for a time to take refuge in Germany. Misfortune dogged his footsteps but he did not despair. "With God's help," he wrote, "I am determined to go on!" And go on he did until finally, in 1581, the seven northern provinces of the Netherlands issued a formal declaration of independence, just as the 13 American colonies did almost 200 years later. Holland was now a separate nation under the leadership of William of Orange, who was the "father of his country," just as George Washington was of his. William now settled at Delft and, with the remnants of his former wealth, supported himself in a simple unostentatious style.

Meanwhile King Philip had taken the despicable step of putting a price on William's head. In 1584 an assassin, animated by religious fanaticism and by the hope of reward for his family, shot and mortally wounded the heroic leader. Unlike Washington, William did not live to enjoy the fruits of the struggle to which he had given his life, but his place as the creator of a nation is just as firmly fixed.

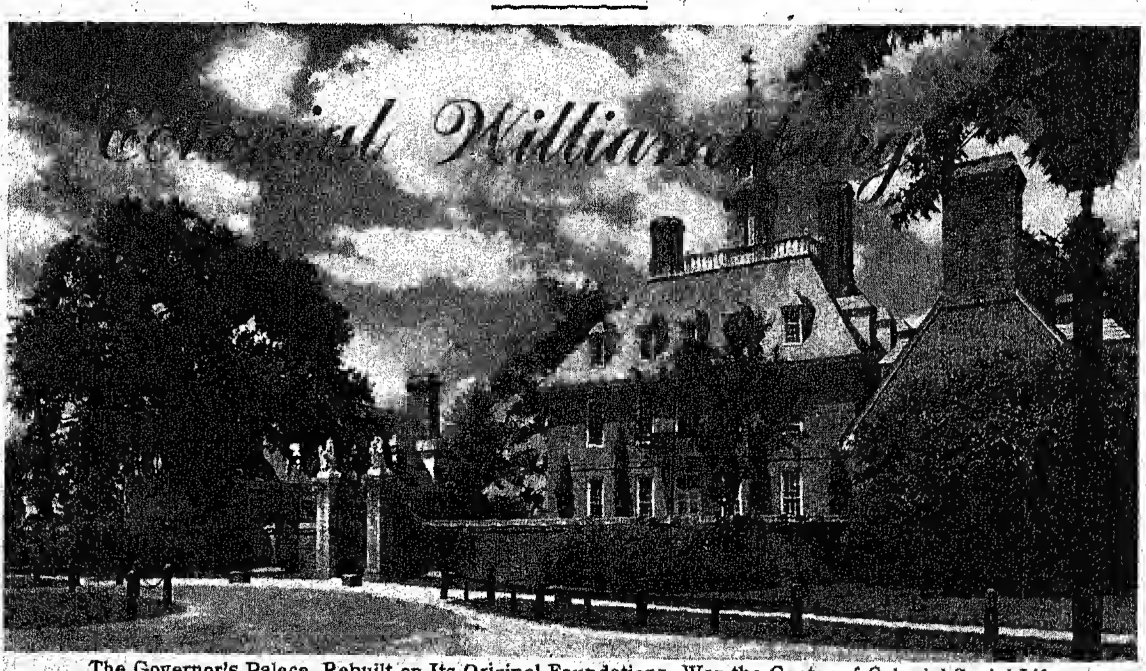
WILLIAMS, ROGER (about 1603-1683). An exile for the sake of religious liberty, Roger Williams had to found a city and a state before he could worship in his own way. He is justly called one of the fathers of American democracy, for the American ideal is rooted in the causes for which he fought—free opportunity, special privilege for none, liberty of worship, and complete separation of church and state.

Williams was born in London and was educated for the church at Cambridge University. Becoming opposed to some of the practises of the Church of England, he migrated to Massachusetts in 1631. There he refused a call to take charge of the church of Boston because it had not formally separated from the Church of England. After a brief term as teacher of Salem church, he became assistant pastor at Plymouth, where he studied the Indian languages.

Meanwhile he was making himself unpopular with the Massachusetts authorities. He held that government had no authority over men's consciences. He also declared that the king of England had no right to grant lands in America without payment to the Indians. When, in 1635, the General Court banished him for his "new and dangerous opinions," Williams fled to the Narragansett Indians. The friendship then cemented later made him a mediator between the Indians and the colony which had expelled him.

In June 1636 he and a few followers founded the first settlement in what is now the state of Rhode Island. In grateful memory of his escape he called it Providence. The lands were purchased from the Narragansett chiefs Canonicus and his nephew Miantonomo. More settlers came, and under Williams' leadership they framed a government which was a pure democracy, with no magistrates, no established church, and complete religious liberty. In 1639 he baptized several of his companions and organized what is generally accepted as the first Baptist church in America.

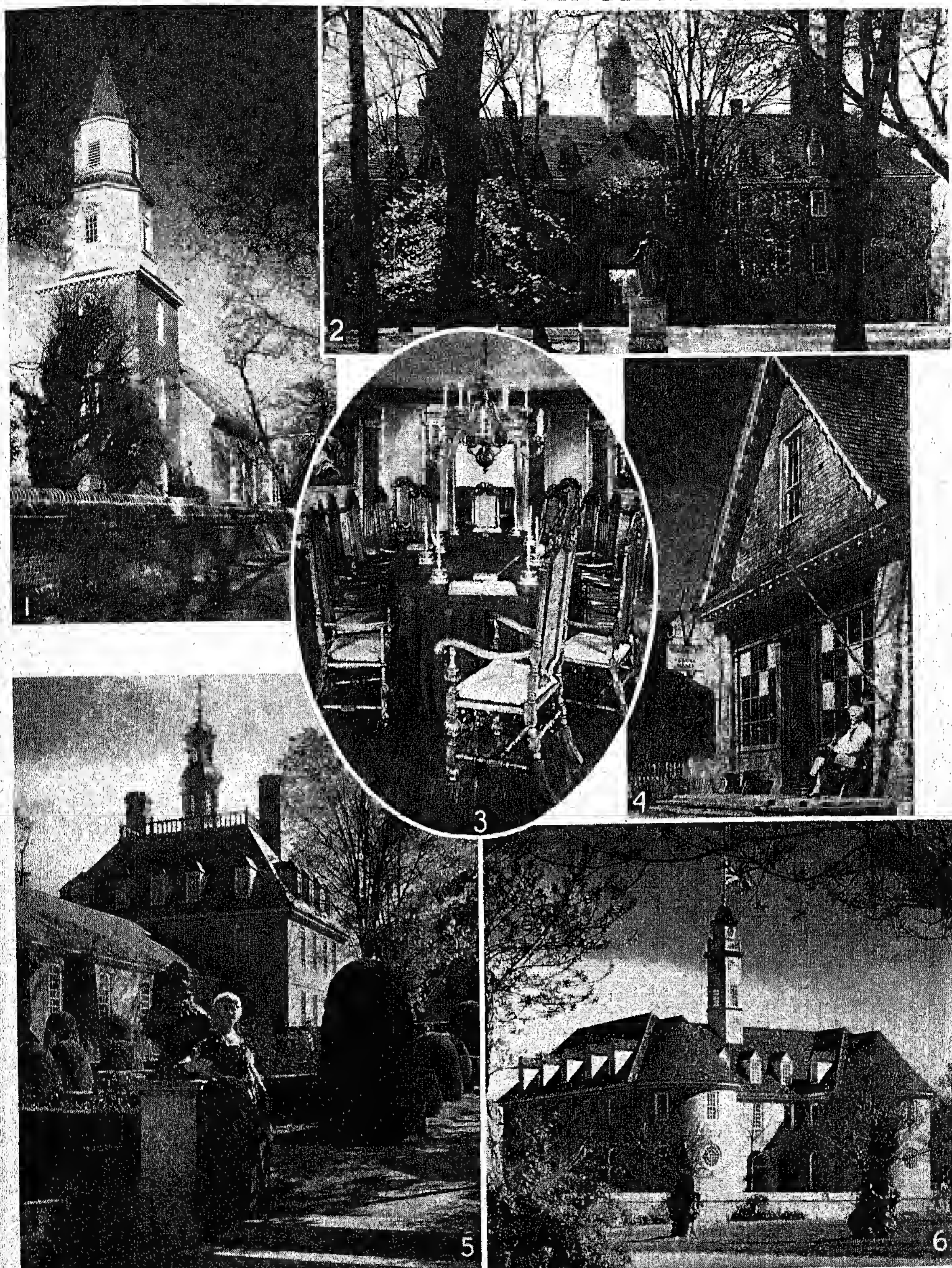
To protect his colony and its neighbors from the claims of Massachusetts, in 1643 he returned to England and the following year obtained a charter for the "Providence Plantations." In 1651 he again went to England to get the charter confirmed. During a three-year stay he became the friend of Oliver Cromwell, Milton, and other Puritan leaders, and published several controversial religious tracts and a key to the Indian languages. From 1654 to 1657 he was president of the colony. His last years were saddened by King Philip's War, in which Providence was laid in ashes and the Narragansetts were defeated and enslaved. He remained active in colonial affairs until his death. His grave may still be seen in Providence and there is a memorial to him in Roger Williams Park. His statue stands in Statuary Hall, Washington, D.C. When Rhode Island celebrated its tercentenary in 1936, the Massachusetts legislature voted to pardon Williams and to revoke the order of banishment.



The Governor's Palace, Rebuilt on Its Original Foundations, Was the Center of Colonial Social Life

WILLIAMSBURG, VA. "That the future may learn from the past" is the motto of the beautiful colonial city which John D. Rockefeller, Jr., restored to its 18th-century appearance. In the heart of the modern city an area about a mile long and half a mile wide recaptures the life of America 200 years ago. Williamsburg was the capital of Virginia from 1699 to 1779, and the commercial, social, and cultural center of the colony. It lies on the peninsula between the estuaries of the James and York rivers.

GLIMPSES OF VIRGINIA'S ANCIENT CAPITAL



1. Bruton Parish Church (1710-15), oldest Episcopal Church in continuous use in America. 2. The restored Wren Building of the College of William and Mary, only building in America designed by Christopher Wren. 3. The Council Chamber of the Capitol. 4. Shop of the peruke-maker and barber. 5. The formal boxwood gardens of the Governor's Palace. Excavations revealed the location of paths, terraces, brick steps, canal, and fish pond, and descriptions of colonial gardens were followed in the plantings. Costumed guides and attendants lend reality to the Williamsburg scene. 6. The Capitol, built in 1701-05, was burned in 1747, rebuilt in 1751, and again burned in 1832. The earlier of the two buildings was reconstructed.

In 1633 a palisade was built across the peninsula to protect the settlers at Jamestown from the Indians. The site of Williamsburg was then known as Middle Plantation because it was the middle of three plantations guarding the palisade. In 1693 the Jamestown government ordered that Middle Plantation "be the place for erecting the College of William and Mary." This was the second university to be founded in the colonies. Six years later the capital was moved to Middle Plantation, and the new town was named for William III, then king of England.

For the next hundred years Williamsburg witnessed the pageant of colonial life at its most colorful and dramatic. Its public buildings were the finest in the country, its social life surpassed only by the Court of England. The Capitol rang to Patrick Henry's martial speeches, which sowed the seeds of revolution; and here was adopted George Mason's Declaration of Rights, forerunner of the Bill of Rights in the Federal Constitution. In William and Mary College were educated Jefferson, Monroe, John Marshall, and the Randolphs. Washington took his examinations for county surveyor here, and in 1788 he became chancellor of the college. It established the first schools of law, modern languages, history, and political economy; the first honor system; and the first elective system of studies. The Phi Beta Kappa society was founded here in 1776.

After the seat of government was moved to Richmond in 1779 the city suffered a decline. Many of the beautiful homes and public buildings were burned; others fell into ruins. The dream of restoring Williamsburg had long been entertained by Dr. W. A. R. Goodwin, rector of Bruton Parish Church. He himself had restored the church and the home of George Wythe, colonial jurist and statesman. At his invitation Mr. Rockefeller visited Williamsburg, and agreed to finance the undertaking. In the course of the restoration nearly 600 modern buildings were demolished or moved away, nearly 200 were rebuilt on their original foundations, nearly 100 were restored. A highway was diverted, two miles of railroad track shifted, and electric wires hidden underground.

To guide in the restoration, workers depended chiefly on the Act of the General Assembly (1699), which set forth in smallest detail the street plan and directions for the building of the Capitol. A map made by an unknown Frenchman designated to scale every building in the city as of 1782. A copper-plate engraving of about 1740, discovered in the Bodleian Library at Oxford, gave the only existing views of the Governor's Palace and the first Capitol. The colonial custom of making minute inventories of household possessions helped in the reproduction of interiors. Material dug up in excavating foundations yielded priceless archeological data.

The principal avenue is Duke of Gloucester Street. At the west end stands the main building of William and Mary College designed in 1695 by Sir Christopher Wren, the great English architect. It is flanked by the Brafferton Building (1723), which housed the first permanent Indian school in the colonies, and by the President's House (1732). Facing the college, about a mile distant, at the east end, is the reconstructed Capitol (1701–05). Spacious greens were laid out in the center of the city, one of them leading north from Duke of Gloucester Street to the Governor's Palace (1705–22) and its magnificent gardens. Along the main and side streets stand the Raleigh Tavern and other inns, the Gaol, the Courthouse, and shops in which the various colonial crafts are again pursued.

Much of Williamsburg is included in the Colonial National Historical Park, which embraces also Jamestown and part of Yorktown, but it is owned and operated by two corporations set up by Mr. Rockefeller.

The modern city is engaged primarily in catering to tourists and college students. It is the seat of the Eastern State Hospital, oldest public asylum for the insane in America (chartered in 1768). Population (1940 census), 3,942.

WILL-O'-THE-WISP. The ghostly patches of light that sometimes float over marshes on warm evenings are variously known as will-o'-the-wisp, jack-o'-lantern, spunkie, and *ignis fatuus* (Latin for "vain fire"). They have given rise to many superstitions. One is that they are bog-sprites that lure lost travelers to their death in swamps. Another is that they are "corpse-candles," carried by ghosts. Science offers several explanations. Some of these lights may be phosphorescent gases from decaying plant or animal matter, blown about by air currents. Others may be "fox-fire," or luminescent decayed wood. Swarms of luminescent insects, or luminescent bacteria carried up by bubbles of rising gas, would have a similar appearance. (*See* Phosphorescence and Luminescence.)

WILLOW. Symbol of sorrow and of grace, the willow was beloved by the ancients. It figures in Greek mythology, and often appears in the decorative art of China. Its furry catkins give welcome promise of spring, and its beauty makes it a favorite ornamental tree in gardens and parks. Willows have deep, tough roots; and as the trees grow with great rapidity they are widely planted to check soil erosion, especially on stream banks and in highway and railway cuts.

The willows are shrubs or trees, varying in height from a few inches to more than a hundred feet. They grow in moist ground in cold and temperate regions throughout the world. The trees are commonly crooked or inclined, with several trunks produced from a common root. The leaves are long, narrow, and sickle-shaped; the bark, thick and furrowed.

Botanists differ as to the number of species, their estimates ranging from 160 to 300. Some 60 or 70 species are native to North America. The largest and the most abundant is the black willow, so called from its dark bark. This tree is common in the eastern part of the continent from New Brunswick to Florida and as far west as the foothills of the Rockies. It also grows in California and the Southwestern states. The glaucous willow, or pussy willow, usually grows

as a shrub. It is found along the banks of streams from Nova Scotia to Manitoba and throughout the eastern and middle western states.

The magnificent tall white willow, found in cultivated ground, is probably a descendant of the white willow of Europe, which was early introduced into the United States and has become generally naturalized. It has no equal among the native American willow trees. With the crack willow it furnishes the most valuable wood of the genus. The latter is a beautiful tree sometimes 100 feet high with a full round head. Its leaves, clear green and shining on top and whitish underneath, make a most attractive picture as they flutter in the breeze.

THE HARDY PIONEER, BLACK WILLOW

The Black Willow, not content to multiply by seeds and roots, founds new willow colonies by means of its brittle twigs, especially when it grows by the water.

The weeping willow came originally from China, where it is a favorite tree, and though it is of practically no economic value, is much cultivated throughout Europe and the United States for its beauty.

The wood of the willows is white, soft, and light, and is more durable in water than any other common timber. It is used for poles, baseball and cricket bats, farm tools, etc., and makes a fine charcoal. Paper is made from the wood pulp of the white willow. An important industry has developed from the use of certain species, usually shrubs, known as osiers, in basket-making and wicker work. The bark is used in tanning and is the source of the medicinal extract "salicin," used for rheumatism. Willow lumbering is a big industry along the lower Mississippi.

Generic name of the willows, *Salix*, from the Celtic *sal*, meaning "near," and *lis*, meaning "water"; with the poplars they form the family *Salicaceae*. Black willow, *S. nigra;* white willow, *S. alba;* weeping willow, *S. babylonica*, so named by Linnaeus, who thought it native to the Babylonian region; crack willow, *S. fragilis;* pussy or glaucous willow, *S. discolor*. The osiers include the European velvet willow, *S. viminalis*, and the golden willow, *S. vitellina*.

WILMINGTON, DEL. The American nation owes much to Wilmington, which lies at the junction of the Brandywine, Christina, and Delaware rivers. The famous brig *Nancy*, chartered in 1775 by Robert Morris to bring munitions from the West Indies, was built in the city. The first iron steamship and the first iron sailing vessel (1854) were built here. The Brandywine mills (in Brandywine village, across the river from Wilmington) furnished flour and meal to the patriot troops during the Revolution. Powder for all American wars since 1802 has been furnished by the Du Pont Powder Mills, founded by Jefferson's friend, E. I. du Pont de Nemours, who had learned the art of powder-making under Lavoisier, the great chemist and superintendent of the French government powder works. During the World War of 1914–18 the Du Pont company made about 40 per cent of all the explosives used by the Allied armies. But the explosives have long been made in plants outside the state, and are normally only a small part of the company's immense output of plastics, dyes, paints, varnishes, and other chemical products. In the laboratory and experiment station at Wilmington many new products are developed, but the manufacturing is done in factories scattered over the country. Building ships and boats remains an important industry. Other manufactures are leather, vulcanized fiber, and railway cars. The deep harbor and marine terminal in the Christina River make the city a busy seaport.

In 1638 a Swedish expedition under the leadership of Peter Minuit built Fort Christina at the junction of the Christina and Delaware rivers. Their landing place, "The Rocks," is marked by a monument designed by the Swedish-American sculptor Carl Milles, and presented by the Swedish people in 1938. Holy Trinity (Old Swedes) Church, dating from 1698, is the most notable relic of Wilmington's colonial past. There are also a number of early 18th-century houses, and a few of the 17th century. After 1735 the town received many Quaker settlers. The Quakers are still influential, even in a population with a large foreign element. Population (1940 census), 112,504.

PRESIDENT *in the* FIRST WORLD WAR

How Wilson Achieved Fame as an Educator—How the Governorship of New Jersey Led to the White House—His Two Terms in Office—The Tremendous Problems which Confronted Him and How He Met Them

WILSON, WOODROW (1856–1924). Thomas Woodrow Wilson—he early dropped the Thomas—came of a Scotch family of Presbyterian preachers and teachers, and the early impressions which he received in his father's home, amid the ministerial and college circles of Georgia and South Carolina, gave a stamp to the young man's mind and character which they were never to lose. It was a distinguished family circle, which drew to it many of the eminent Presbyterian leaders of the South during and after the Civil War. And all of its members were closer to Europe, especially England, than most Americans of the time, for British periodicals and British statesmen were studied and Gladstone was a hero of the family. At the time of his son's birth (Dec. 28, 1856), the father, Rev. Joseph Ruggles Wilson, was pastor of the Presbyterian church at Staunton, Va.; but within two years he accepted a pastorate at Augusta, Ga., where his family remained until his removal to Columbia, S. C., to become professor of theology in the Southern Presbyterian Seminary there. The boy was named after his mother's father, Dr. Thomas Woodrow, who had emigrated from England and became pastor of a Presbyterian church in Columbus, Ohio.

After a year at Davidson College, in North Carolina, Woodrow Wilson, in 1875, went to Princeton, where his father had studied theology. At Princeton young Wilson busied himself much more with books of general literature and with the conduct of politics, both American and English, than some of his teachers liked. This bent toward public life was made still more evident when he published a remarkable article, a year before he graduated, on the subject of responsible government. The point of the study was that congressional government, as practiced in the United States, divides responsibility and thus lends itself to inefficiency and corruption. With his mind still drawn toward public life as a vocation, Wilson, after graduation at Princeton in 1879, studied law at the University of Virginia.

His Teaching Career Begins

Two years later, armed with his law diploma, he settled in Atlanta, Ga., where he entered into a partnership and undertook to make his way in the pushing commercial world. In the autumn of 1883 he was again at his books and a member of the graduate classes of Prof. Herbert B. Adams, a famous teacher of history in Johns Hopkins University, Baltimore. He completed the studies for the degree of doctor of philosophy, and shortly afterward published a book entitled 'Congressional Government', a study of American methods of government that attracted immediate attention. After teaching history and political science at Bryn Mawr and Wesleyan universities, in 1890 he was made professor of jurisprudence and economics at Princeton, where he quickly took rank among the foremost teachers in the country.

In 1902 Professor Wilson was elected president of Princeton University. From that time he was one of the educational leaders of the United States and a champion of essential reforms. His immediate work was the re-making of Princeton so as to deepen and broaden its educational work and democratize and stimulate student life. This led to resistance and opposition on the part of some members of the faculty, students, and alumni; and when a sum of several million dollars was offered the university on condition that its expenditure should be controlled by his chief opponents in the faculty, President Wilson was ready to resign.

Becomes Governor of New Jersey

Meanwhile, the president of Princeton had become an influential national character. In 1906 Col. George Harvey, editor of *Harper's Weekly*, called Mr. Wilson a fit candidate for the presidency of the United States, and in his paper kept Wilson's name before the country. In 1910 Wilson was nominated and elected governor of New Jersey under circumstances that made him the outstanding progressive of the Democratic party. During the year 1911 he was supported by a majority of the state legislature, and set the state upon a new and higher social and political level. Then in 1912 the Republicans regained control of the legislature; authority in government was divided, and the result was, as he had predicted in his early essay on government, no government at all.

Governor Wilson was now an avowed candidate for the democratic nomination for the presidency in 1912. But his record as governor had alienated Colonel Harvey and certain distinguished persons enlisted on his behalf by the editor of *Harper's Weekly*. Other support was found in the progressive elements of the Democratic party. The Republican convention at Chicago, early in June, re-nominated President Taft; but the followers of ex-President Roosevelt so resented the "steam roller" methods by which the reactionaries controlled the convention that they withdrew and in August formed the Progressive ("Bull Moose") party, with Roosevelt as their candidate (*see* Roosevelt; Taft).

In the Democratic convention at Baltimore, in late June and July, there was a long and bitter struggle between the progressive Democrats and the various organizations, such as Tammany, which throve upon local patronage and contracts in large Democratic cities. The support of the latter gave Champ Clark of Missouri, the speaker of the House of Representatives, a clear majority on nine ballots, but he could not obtain the two-thirds majority required by the rules to nominate. The support of William Jennings Bryan

WOODROW WILSON

finally brought a two-thirds majority to Governor Wilson, who thus became the Democratic nominee, with Thomas R. Marshall of Indiana as the nominee for vice-president. Wilson proved a good candidate and in the election the Democratic ticket was successful, receiving 435 electoral votes against 88 for Roosevelt and 8 for Taft. But the combined popular vote for Roosevelt and Taft exceeded that for Wilson by more than 1,300,000.

A Political Reformer in the President's Chair

When President Wilson entered office he had the same elements in his own party for enemies that wrecked Cleveland's two administrations. On March 4, 1913, he delivered his first inaugural. He appealed to the forward-looking people throughout the country. "Here muster not the forces of party," he said, "but the forces of humanity." In this he reminded men of Jefferson's first and Lincoln's second inaugural. He called Congress in extra session early in April, addressing the two houses in person, thus breaking a precedent of more than a hundred years. From time to time after that he went before Congress with parts of his plan of general national reform. For more than two years he held that body to a strenuous task. Before his first term drew to a close a great far-reaching scheme of legislation was fairly completed. The tariff that had broken President Taft was reformed downward to a general average of 25 per cent. And a board, led by a tariff expert, was set up to study tariffs and make recommendations to the country. The Clayton anti-trust law was enacted, and the Federal Trade Commission was set up to make it effective and also keep the country informed on the subject of trusts and interstate trade. The Federal Reserve banking system was established against the protest of organized bankers, and a board of control was set to work administering the system. For the first time in American history, finance and credits were placed under government direction. A national income tax, to be levied according to wealth and not according to population, was enacted. It was a graduated tax, its aim being social as well as financial. A farm loan act designed to give cheap and easy credits to farmers and tenants, with a board of operations, closed this series of reforms. They were far-reaching and they are not likely to be repealed. No president had ever secured from Congress so many important laws. No American laws were ever more effectively enforced.

New Policies in Latin America

While Congress labored over the legislative program, President Wilson announced, and gradually if painfully worked out, a new foreign policy. Congress had enacted a Panama tolls law in 1912 that violated the Hay-Pauncefote treaty of 1901 with Great Britain. Wilson persuaded Congress and the country to repeal this law. President Roosevelt had "taken Panama" in 1903 to enable the United States to build the canal. (*See* Panama, Republic of.) All Central and South America was alarmed at what was styled "American imperialism." Wilson addressed South America when he spoke at Mobile, Ala., in October 1913, saying that "the United States would never again seek one additional foot of territory by conquest." President Taft had helped set up a financial arrangement with China whereby American banks were to coöperate with European banks in lending large sums to China, the understanding being that governmental pressure would be applied in the event that collections proved difficult. Wilson announced soon after his inauguration that he would abandon this so-called "dollar diplomacy." The people of Mexico, wearied with the exactions and corruptions of the Diaz regime, had recently overthrown Diaz and set up Madero as a reform president. Huerta caused Madero to be shot and made himself master of the country. Wilson refused to recognize a man "whose hands were stained with blood." He endeavored in "watchful waiting" to aid the Mexican people to find a government to suit themselves. Throughout Wilson's two terms that policy was adhered to against the bitterest opposition and this restored in large measure to the United States the good will of all Spanish America.

The President Insists on Neutrality

Before the country was asked to vote its approval in the elections of 1914 upon this new and far-reaching policy, Europe was plunged into war (*see* World War of 1914–1918). Americans were then little acquainted with international politics. The Democratic party, which Wilson represented, was even less informed on European affairs than were the Republicans. Moreover, the country contained millions of Germans who still thought in terms of their fatherland; millions of Irish who could never think anything England did was worthy of approval; and yet another group, less distinguishable, who thought the cause of England the cause of all mankind. With these national, party, and racial conditions known to all men, Wilson called upon the country to be neutral even "in spirit." At once all the interested elements of the nation began vigorously to attack his policy. Great industrial establishments soon began to manufacture munitions for the Allies, Germany being hindered from giving contracts by the fact that the British fleet controlled the sea. The Allies sold their great industrial and railway holdings in the United States and applied the money to their immense purchases. For the first time in American history that country ceased to be a debtor to Europe; it quickly became a creditor on an unprecedented scale. In all this Germany was losing. The Germans endeavored through a feverish propaganda to counteract the drift of economic life. The British countered in this. Ardent appeals were made to all racial groups. Unwilling to await the reaction of public opinion the German agents blew up railway bridges and brought on strikes in munition plants. They at last warned Americans to keep off the ocean lest they be sunk by German submarines. In May 1915, the *Lusitania*, a British transatlantic steamer, was sunk, and more than 100 Americans,—men, women and children—were

drowned. Neutrality either in fact or in spirit seemed impossible. Yet Wilson, speaking to incoming immigrants a few days after the *Lusitania* went down, said there was such a thing as being "too proud to fight."

It was as difficult to be president in those days as it was when Washington was seeking to maintain a similar neutrality in the struggles between Revolutionary France and England in 1793–96. At a critical moment in August 1916, when American railroads were bearing their greatest burdens of munitions and supplies for the Western Front in Europe, and when American economic life was considerably deranged, the railway workers of the country decided to strike for better wages and for the eight-hour day. Wilson accepted the worker's point of view and asked Congress to enact, in the greatest haste, what is known as the Adamson law, granting what they asked. His recommendations also covered the whole railway labor problem, including the guarantee to the government in the future of absolute control, in the interest of the public. The latter recommendations did not receive serious attention.

Wilson was renominated in 1916 upon a peace platform. Charles E. Hughes, the Republican candidate, was vague in his stand on issues arising from the war. Wilson won with a plurality of nearly 600,000 votes; but the issue was for some days in suspense, and the change of 2,000 votes in California would have so altered the electoral vote as to give victory to Hughes.

Immediately after the result was known, President Wilson began to prepare a plan for effective American mediation looking toward a lasting peace, and sent for the ambassadors to England and Germany, while his confidential friend, Edward M. House, held conversations in New York with the representatives of the warring powers. With the apparent purpose of forestalling this effort of the President, Germany offered on December 12 her famous plea for a peace conference without any indication of the terms Germany would accept. Nothing daunted, Wilson continued his efforts, and on Jan. 22, 1917, he embodied his peace proposals in a speech to the Senate. He talked of a "peace without victory" and laid down several of the points later included in the famous fourteen. The Allies rather resented his suggestion of a drawn battle. Germany replied by announcing, on January 31, her campaign of unrestricted submarine warfare, and indicated to all neutrals the narrow lanes on the seas through which a few designated ships might pass. Shortly afterward the "Zimmermann note" fell into the hands of the government, in which Germany offered Texas and other American territory to Mexico if that country would join Japan in attacking the United States.

Wilson answered Germany's submarine declaration by dismissing the German ambassador (February 3) and asking Congress for a declaration of armed neutrality (February 26) which could hardly fail to become open war within a few months. A "handful of willful men" in the Senate defeated the armed neutrality measure in spite of great majorities in its favor. Nevertheless the government began in earnest to prepare for war. On April 2 Wilson addressed both houses of Congress asking a formal declaration of war. On April 6 Congress declared war by overwhelming majorities.

This meant American intervention in European affairs, a dangerous thing in view of the history of the country and the many racial antagonisms in American life. The President promptly made it a war for democracy. In all his declarations, from April 1917 to October 1918, he preached a crusade for democracy. In that way he influenced and moved the whole world, lifting the more liberal elements of the western Allies to a higher level of idealism, and putting the imperial-

WILSON'S ADMINISTRATIONS
1913-1921

17th Amendment, for Election of Senators by the People (1913).
Underwood-Simmons Tariff lowers Duties.
Federal Reserve System of Banks created.
Federal Trade Commission created (1914).
Clayton Anti-Trust Act passed.
Graduated Income Tax Law passed.
Panama Canal Tolls Act repealed.
Panama Canal opened.
Many Arbitration Treaties negotiated by Secretary of State Bryan (1913–14).
Neutrality declared in the World War (1915).
Tariff Commission created (1916).
Adamson Railway Employees' Law enacted.
Expedition to the Mexican Border.
Wilson reëlected on a Peace Platform (1916).
Proposes "Peace Without Victory."
Germany announces Unrestricted Submarine Warfare (Jan. 31, 1917).
German Ambassador dismissed (Feb. 3, 1917).
War declared against Germany (April 6, 1917).
Two Million American Soldiers sent to France (1917–18).
"Fourteen Points" proposed as Peace Basis (Jan. 8, 1918).
Republicans gain control of House and Senate (1918).
President attends Paris Peace Conference (1918–19).
18th Amendment, for National Prohibition (1919).
Treaty of Peace with League of Nations Covenant submitted to Senate (July 10, 1919); fails to receive two-thirds majority (Nov. 19).
President stricken on speaking tour in behalf of the Treaty (October 1919).
Woman Suffrage established by 19th Amendment (1920).

ists of Germany and her supporters upon a lonely defensive which was most difficult to sustain. In order to make these American ideals known, President Wilson created the Committee on Public Information, headed by George Creel and guided by a group of college professors and journalists of the more democratic type. This publicity bureau, in daily touch with the President, played as great a rôle in bringing the war to an end as did many of the generals of the Western Front. It was a battle of ideas as well as a battle of guns.

America's Wonderful Mobilization

The moment war was declared, the President showed the greatest energy. The industrial forces of the country were promptly organized under the leadership of a Council of National Defense. In similar manner the railways were brought under a government leadership whose business it was to economize railway space and tonnage. The scientific talent of the time was organized for promoting invention and for adapting the engineering resources of the country to the new emergency. Contrary to the habits of Anglo-Saxon communities, universal conscription was promptly enacted, and before mid-summer of 1917 immense training camps were opened at convenient points and millions of young men were speedily collected for intensive training. The munition plants already engaged in supplying the armies of England and France continued their operations, while the early contingents of the regular army and the National Guard were supplied with guns and shells from the stores of the Allies. A national Shipping Board was set to work to build millions of tons of shipping, and hundreds of millions of dollars were supplied makers of aircraft both for devising the best types and for building up-to-date planes, although much of these appropriations was apparently wasted. Altogether 2,000,000 soldiers were placed on the Western Front before armistice day, Nov. 11, 1918, and about 3,000,000 more were in training camps. The navy personnel was raised from fewer than 100,000 to more than 300,000.

In financing the war, the administration achieved outstanding success. The size of the task may be judged from the fact that by June 30, 1919, the government had spent more than $22,625,000,000 on the war and had lent more than $9,455,000,000 to the Allies. These vast sums were raised by direct taxation and by bond issues sold to the people. By means of the income and excess profits taxes more than $3,000,000,000 was raised in the fiscal year ending June 30, 1918, and twice that amount was raised for the next year. The Federal Reserve banks and the Treasury conducted the far-reaching loan campaigns at small cost to the country. In no other war had there ever been such a just distribution of the burden of taxation. Nor were the bonds of previous wars sold at par and without "rake-offs" to the brokers. Wilson was the soul of a vast idealism which he in large measure inspired and which the dangerous condition of the world aided him in calling forth.

Just as the American army was driving the Germans before it in the Argonne, and another army was being formed for a "drive" upon Metz, the strongest position of the enemy, the Central Powers began to collapse. Bulgaria surrendered at the end of September. A few days later Austria surrendered to Italy. On October 5, Germany began negotiations with the President, proposing the Fourteen Points—terms which Wilson had announced for America and the Allies on Jan. 8, 1918—as the basis of settlement.

The advantages of a "war for democracy" had been so great that few had challenged Wilson during the struggle. But freedom of the seas, self-determination of peoples, the greatest measure of free trade, and a league of all nations organized to prevent wars, seemed quite a different thing when claimed by the Germans as terms on which they would surrender. The great problem of Wilson's life was at hand demanding solution. The German proposals came in the midst of the congressional elections of 1918. The fear that the liberal terms of Wilson might be accorded to Germany, against whom all men had been called to fight to the uttermost, was a determining influence. The economic opponents of Wilsonism united with the racial groups of the country who had been most affronted at the declaration of war upon Germany or at the making of what amounted to an alliance with Great Britain. In spite of an appeal of the President to the people to return a Democratic majority to both houses of Congress, to avoid divided authority, the Democrats lost the election upon a plurality of more than 2,000,000 votes.

A few days after the election, Nov. 11, 1918, the armistice was signed. Its basis was the Wilson points above mentioned, except that Great Britain obtained the omission of the freedom of the seas. When Congress opened, although it was still Democratic on safe margins, it became clear that the President could not lead it as he had hitherto done. A third time in his life he was confronted with that division of authority which he had lamented in his first studies upon the subject of government at Princeton, 1907 to 1910, in the governor's office of New Jersey in 1912, and now in Congress at the greatest moment of his life and of world history.

The Peace Conference and the League

He sought to carry out his policies, in spite of the fatal defects of the American situation, by going in person to Paris and there in the assembling Peace Conference persuading Europe of the value of democracy and idealism. All European governments had agreed to his fourteen points. For two years the Western Allies had been accustomed to his leadership. But the French parliament announced by an overwhelming majority that France would not accept a Wilsonian peace. The British, on December 14, just as the President arrived in Paris, announced in a national election that Germany must pay to the "last farthing," which was directly opposed to the Wilson policy. Italy was known to stand defiantly for an imperialist

peace in the Adriatic. Europe had quickly rallied against the President. The victory was too complete for men's cupidity. Against this Wilson endeavored to stir the democratic forces of Europe. In this he was treading dangerous ground. If he went too far, general revolution might ensue. That would endanger all. When the Conference met, Wilson stood isolated, with all the Allied diplomats arrayed against him.

The peace as agreed upon in June 1919 did contain many of his ideas. Many new states appeared on the map of Europe—Poland, Czechoslovakia, Yugoslavia, Latvia, and others. The League of Nations was definitely provided for. Backward countries were to be governed under mandates. And there was to be general disarmament. These were Wilson ideas. But the Germans were to be subjected to many harsh terms. On July 10, 1919, he laid the treaty before a hostile senate, which prepared to undo all the "Wilsonism" in the treaty.

Meanwhile Wilson went before the country to defend his work. He was well received, but he was stricken dangerously ill at Wichita, Kan., late in September. He hastened to Washington where he kept to his bed many months. The violent and bitterly partisan debate in the Senate continued till March 1920, when the treaty was returned to him with "fourteen" reservations. Only one of these was really important, the one which proposed the elimination of Article X from the covenant of the League of Nations. From the Wilson point of view no league of nations could function without the support of an international army or navy in possible contingencies. He refused to accept any reservation destroying this sanction.

PRESIDENT WILSON'S FOURTEEN POINTS

I. "Open covenants of peace, openly arrived at," and abolition of secret diplomacy.
II. "Absolute freedom" of the seas.
III. "Removal of all economic barriers" and the "establishment of an equality of trade conditions."
IV. Reduction of armament to the "lowest point consistent with domestic safety."
V. "Impartial adjustment of all colonial claims" with equal consideration for the claims of the sovereign state and the interests of the population concerned.
VI. "Evacuation of all Russian territory," and the freedom for Russia to determine her own "political development and national policy."
VII. Evacuation of Belgium and her restoration to full sovereignty.
VIII. Evacuation of French territory and the restoration of Alsace-Lorraine.
IX. "Readjustment of the Italian frontier" along "clearly recognizable lines of nationality."
X. Autonomy for the peoples of Austria-Hungary.
XI. Evacuation and restoration of territory to Rumania, Serbia, and Montenegro; free access to the sea for Serbia; adjustment of the Balkan relations along the lines of "allegiance and nationality"; international guarantees for the independence and territorial integrity of the Balkan states.
XII. Autonomy for alien peoples under Turkish rule and the internationalization of the Dardanelles.
XIII. Erection of a Polish state with access to the sea; its independence and territorial integrity to be guaranteed by international covenant.
XIV. Formation of "a general association of nations for the purpose of affording mutual guarantees of political independence and territorial integrity to great and small states alike."

Rejection of the League

For more than a year the government had been a divided house. There was nothing to do but await the next election. When the Republican national convention met in Chicago, in June 1920, its platform was of course against him. The Democratic national convention, which began in San Francisco June 28, made a great show of enthusiasm for President Wilson and his achievements, but its nomination of James M. Cox was dictated by the element within the party which had always hated and feared the President. Governor Cox, however, fought valiantly for the League of Nations, though he was evidently willing to accept certain reservations. An overwhelming Democratic defeat resulted.

After his retirement from office, Mr. Wilson continued to make Washington his home. He discontinued all political activity, save for a few letters and public utterances in favor of the League. Though the left side of his body was paralyzed, his invincible will brought about a partial recovery and held death at bay for more than four years.

When the end finally came on Feb. 3, 1924, it brought a widespread sense of personal loss. Whatever may be his ultimate place in the hall of fame, he indisputably exercised a deeper influence over world affairs than had any other American president. He was buried without pomp, in the National Cathedral of St. Peter and St. Paul at Washington.

WINDMILLS. As long ago as the 12th century men had learned to use the power of the wind to grind corn and pump water by means of windmills, which were introduced into Europe from Saracen countries. Within recent years the gasoline motor is in many places displacing windmills on American farms, particularly where the winds are unreliable.

Windmills are of two chief types: the older type which lends such charm to the landscapes of Holland and other parts of Europe, with four or six huge sails 30 feet or more in length; and the modern or American type, which has many fan blades arranged in a wheel usually 12 or 16 feet in diameter, mounted on wooden or steel framework towers from 50 to 70 feet high. Instead of many blades, the best windmills now have two or four blades, resembling airplane propellers.

These new windmills, sometimes called wind motors, are designed to drive a small dynamo while maintaining a more or less constant speed of rotation, regardless of variations in the force of the wind. However, it has been found difficult to achieve steady speed.

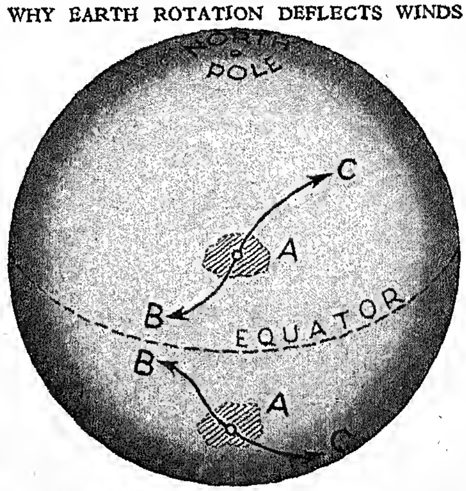
In the older type the sails—which are great arms usually covered with canvas—are kept facing the wind either by rotating the entire tower or by moving the dome to which the sails are attached, either by hand, or by a rudder or vane which automatically shifts the dome when the wind veers. In the American type the vane is used almost exclusively.

WINDS. Without winds, the face of the earth would be very different from what it is. Next to water, wind is the greatest force in nature for wearing down rocks and scooping out canyons and valleys with constant blasts of sand. This is called *wind erosion.* In some places the wind buries fertile soil; in others it lays down rich deposits, such as the *loess* soil of northern China. But the most important daily work of the wind is in creating weather. This makes the study of winds a most important branch of science.

Local Winds

"The wind bloweth where it listeth," says the Gospel of St. John, expressing the mystery men always have found in the winds. But today we know that all winds, from gentle breezes to raging hurricanes, are caused by differences in atmospheric pressure. Perhaps the simplest example is found in *land-and-water* breezes.

WHY EARTH ROTATION DEFLECTS WINDS



Suppose we are at A in 30° north latitude. If the air is calm, it rotates eastward with the surface of the earth at a speed of 899 statute miles an hour. Suppose now some force drives a mass of this air southward to 20° north latitude, where, because of the greater distance from its axis, the earth's surface is rotating at 975 miles an hour. The air, therefore lags 76 miles an hour behind the earth's surface. This lag causes a deflection to the westward, as shown by the arrow B. On the other hand, a movement of air northward from 30° to 40° would take it to a region where the surface rotates at only 795 miles an hour. The air then would be moving eastward 104 miles an hour faster than the earth's surface, and hence would be deflected toward the northeast in the direction of C. Under the same conditions, similar deflections occur in the southern hemisphere, as the picture shows. Of course, friction, contact with air in the region entered, and other factors reduce the actual wind velocities far below the figures given.

Sunshine pours down upon land and water alike, and warms them. Over oceans and lakes, most of the heat energy is consumed in evaporation, or is absorbed by the water; the air does not become greatly heated. But land absorbs only six-tenths as much heat as water does, and evaporation is less. Hence over land, the air receives a greater share of the heat than over water.

Heated air expands, and exerts less pressure than before. When this occurs over the land soon after sunrise, the sea air, which has greater pressure because it is colder, forces its way landward. This movement is the day *sea breeze.* At night, land cools more quickly than water, and the breeze is reversed.

Similar day-and-night pressure changes cause *mountain-and-valley* breezes. By day, the greatest heating takes place along mountain sides and at the heads of valleys. Pressure from below then starts a breeze blowing up the valleys. At night this action also is reversed.

The General Circulation of the Air

Pressure differences likewise cause world-wide air movements known as planetary winds. Throughout the year the most intensely heated portion of the earth is the tropical zone, which is centered upon the Equator. The abundant heat here keeps the air pressure low, and denser air continually pushes in from both sides. But the central part of this zone has little wind, because the chief air movement is upward, as the heated air is forced up by the incoming cooler air. As the ascending air cools, its moisture condenses into clouds and keeps the zone drenched with steaming showers. Sailors were often becalmed for weeks in these latitudes and so called them the *doldrums,* from an old word meaning "dull" and "stupid."

The flow of air in from each side constitutes the *trade winds,* so called from the old meaning of "trade" as a steady track. The trade winds, however, do not blow directly toward the Equator. They are deflected by the earth's rotation, as the diagram shows.

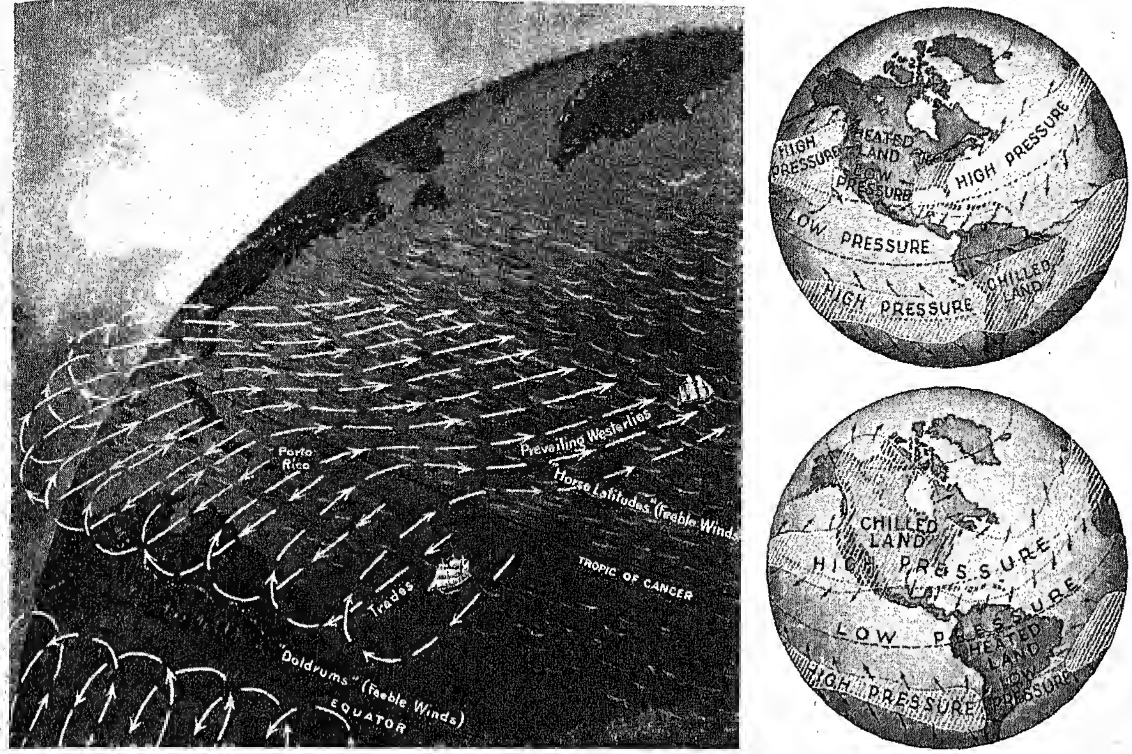
Beyond the regions of the trades on each side of the Equator is another calm belt called the *horse latitudes* —some say because becalmed ships laden with horses often ran short of water, and the sailors had to throw the horses overboard. Two specific pressure conditions cause these calms. First of these conditions is the behavior of the air which is driven upward at the Equator. After ascending, the air flows toward both poles at a level well above the trade winds. It becomes cooled, acquires higher pressure, and settles to the earth near the parallels of 30° north and south. Since this settling is very nearly straight downward, these high pressure belts have little wind. After settling, the air continues its poleward movement and becomes deflected to constitute the *prevailing westerlies* of the middle latitudes (temperate zones). This entire movement in the upper atmosphere and in the region of the westerlies is called the *antitrades.*

The second condition which causes calms in the horse latitudes arises in summer. As the article on Climate explains, less heat is received from the sun as distance from the Equator increases. Air pressure therefore tends to become higher. But the greater the distance from the Equator, the longer the day in summer and the greater the number of hours of sunlight. Throughout the middle latitudes, this increase in hours of sunshine more than makes up for its lessened intensity. Hence, pressure decreases in summer in these latitudes, leaving an area of *semi-permanent high pressure* near the Tropics of Cancer and Capricorn. This pressure reinforces the antitrades.

Westerlies and Cyclones

The characteristic planetary wind of middle latitudes is the prevailing westerly. At sea the westerlies are so strong that the 40th degrees of latitude are called "the roaring forties." In the northern hemi-

TRADE WINDS, WESTERLIES, AND WHY THEY BLOW



The larger picture shows the North Atlantic system of *trade* and *westerly* winds. The Pacific Ocean has a similar system; so does the southern hemisphere, with reversed directions. All these winds together are called planetary winds. They are caused by great belts of high and low pressure around the earth, as explained in the text. The pictures at the right show how a continent breaks up both the pressure belts and the planetary winds. In summer, the land is hotter than the ocean, as shown for the northern hemisphere in the upper picture. Hence the air pressure over the land is usually lowered, and the winds take the directions shown by arrows. In winter, air pressure over the cold land usually is higher than it is over the ocean, and the influence upon the winds is reversed, as shown in the lower picture. The *monsoons* of Asia are created in this way.

sphere, the influence of the continents breaks up the regularity of these winds, as the diagram shows. They are disturbed also by cyclones (*see* Weather; Storms). The southern hemisphere, however, has few great land masses; so here the westerlies blow without interruption. They are especially strong, as are the trade winds, in the South Indian Ocean.

Special Terms and Wind Names

Winds are named for the direction from which they come; a north wind blows *from* the north. Certain winds have received the following special names:

Blizzard (North America) and *Buran* (Siberia). A cold wind, usually from north or northwest. Moisture encountered in its advance is changed to fine, driving snow. In Texas such a storm is called a *norther.*

Chinook (Rocky Mountains) and *Foehn* (Alps). A *compression wind,* that is, a stream of descending air warmed by compression. It often clears a region of snow in a few hours.

Etesian Wind (Eastern Mediterranean). A seasonal wind, driven from the north toward the Sahara in summer, from the Near East highlands toward the sea in winter.

Mistral (Mediterranean). A cold dry or misty wind blowing from the Alps.

Monsoons (Southeast Asia and Northeast Africa). Seasonal winds caused by heating and cooling of the continental land masses. In summer, continental low pressure draws moist winds from the Indian and Pacific oceans; the moisture condenses as the wind rises over the land, and this monsoon is *wet.* In winter the *dry monsoon* blows from the continental area of high pressure, toward the oceans. Monsoon winds control the agriculture of India, China, the Malay Peninsula, the Malay Archipelago, and Ethiopia. The American Gulf States also have monsoon winds, but less intense than those of Asia.

Sirocco (Mediterranean). A hot, dust-laden wind from the Sahara Desert.

Velocity by the Beaufort Scale. A convenient, rough method of estimating wind velocity by using "indications" originally grouped into a scale for sea use by the British admiral, Sir Francis Beaufort, in 1806. Land indications follow:

Scale Number	Speed (statute mi.)	Wind Name	Indications on Land
0	Under 1	Calm	Smoke vertical
1	1 to 3	Light Air	Smoke drifts
2	4 to 7	Slight Breeze	Face feels wind; leaves rustle
3	8 to 12	Gentle Breeze	Leaves, small twigs in constant motion
4	13 to 18	Moderate Breeze	Raises dust, paper; small branches move
5	19 to 24	Fresh Breeze	Small trees sway; wavelets on lakes
6	25 to 31	Strong Breeze	Large branches move; umbrellas blown
7	32 to 38	High Wind.	Whole trees move; walking difficult
8	39 to 46	Gale	Twigs broken off
9	47 to 54	Strong Gale	Loose shingles and chimneys go
10	55 to 63	Whole Gale	Some trees uprooted
11	64 to 75	Storm	Widespread damage
12	Above 75	Hurricane	Anything may go

WINDSOR. About 21 miles west of London, in Berkshire, lies the borough of New Windsor, with the famous Windsor Castle. William the Conqueror saw the value of this site, on a chalky rise near the right bank of the Thames, and built a castle there. This and later castles on the same site have been favorite residences of English royalty ever since. On the spot where legends tell that King Arthur used to gather with his Knights of the Round Table, Edward III built the Round Tower or Keep as a meeting place for the Knights of the Garter. Albert Chapel in the Lower Ward once belonged to Cardinal Wolsey and was restored by Queen Victoria as a memorial to her husband. The Gothic Chapel of St. George contains many royal tombs, including those of Henry VI, Edward IV, Henry VIII and Jane Seymour, Charles I, George III, George IV, and George V. In a beautiful garden to the east is the Upper Ward, with the private apartments of royalty, visitors' rooms, and state apartments. These include the Throne Room and St. George's Hall, where the Knights of the Garter now meet. (For picture, *see* England.)

South of the castle are the great Royal Mews, or stables; and a little beyond, at Frogmore, is the mausoleum of Queen Victoria and her husband. Here also the Long Walk leads through double rows of fine oaks and elms for three miles to the Great Park, with its beautiful artificial lake Virginia Water. To the west is a remnant of the celebrated Windsor Forest.

On the opposite side of the Thames rise the towers and ivy-covered buildings of Eton College. This famous old school, which numbered Gladstone, Gray, Shelley, Wellington, and many other noted Englishmen among its graduates, was founded in 1440 by Henry VI.

Windsor means "winding shore." The town, properly called New Windsor, has a few old houses, though none that can be dated to the time of Shakespeare's 'Merry Wives of Windsor'. Population, about 20,000.

WINKELRIED (*vĭng'kĕl-rēt*), **ARNOLD VON.** The streams and hedges seaming the field of Sempach forced the Austrian knights to dismount, and the fierce heat of the July day compelled them to doff their armor; but they outnumbered the Swiss mountaineers four to one, and engulfed them hopelessly in bristling ranks of spears. Then from the point of the Swiss wedge sprang forth Arnold von Winkelried and gathered a great sheaf of Austrian spears into his breast. The Swiss poured through the breach, and ere the day closed the Austrians were routed and Duke Leopold lay dead on the field.

Historians today doubt the Winkelried story, but it remains true that Hapsburg power over the Swiss Confederacy was broken at Sempach, July 9, 1386, and that in Switzerland Arnold von Winkelried is a popular national hero.

WINNIPEG, MANITOBA. A frontier trading post in 1871, Winnipeg in fifty years became Canada's fourth city. In this astonishingly short time the hamlet of about 200 pioneers grew into a metropolis with towering office buildings and huge factories, the greatest railroad center of Canada, its chief live stock market, and one of the world's largest grain markets. In place of the former prairie trails there are two transcontinental railroads, with more than a score of branches radiating in all directions.

The reason for the rapid growth of this "Chicago of Canada" rests primarily on its geographical situation. Standing at the junction of the Red and Assiniboine rivers, midway between the southern boundary of Canada and Lake Winnipeg, it is the neck of the bottle through which pass the cattle and grain of the Northwest, and the center from which the manufactures of the industrial East are distributed to the smaller cities and farms of the western prairies.

But this alone does not account for Winnipeg's greatness. The factor which made possible its development as a manufacturing center is the boundless electric power supplied from the Winnipeg River, 60 miles distant. All Winnipeg's coal must be brought great distances, so without this cheap power manufactures could not have succeeded in competition with centers nearer coal supplies. The greater part of Winnipeg's electric power is developed in a great hydroelectric plant owned by the city, and it is sold to consumers at a low rate. Engineers say that there is enough undeveloped power to run all the industries of a city of 1,500,000 population. The varied manufactures include flour and other food products, pulp and paper, railroad cars, farm implements, dairy products, clothing, structural steel, lumber products, meat products, leather goods, brick, and gypsum. Water is brought by a great aqueduct, nearly a hundred miles long, from Shoal Lake.

Winnipeg is a city of wide streets and boulevards, with many parks and playgrounds. It is the capital of Manitoba and the seat of the University of Manitoba, the provincial agricultural college, and several other educational institutions.

The site of Winnipeg was first occupied in 1738 by the French explorer La Verendrye, who built Fort Rouge here. This post was abandoned. In 1806 the North-West Fur Company established Fort Gibraltar (later renamed Fort Garry), and a few years later the Hudson's Bay Company built Fort Douglas close by. In 1812 the nucleus of the colony brought from Scotland by Lord Selkirk settled around these forts. As the hamlet grew it was given the name Winnipeg ("murky water") from the lake 50 miles to the north. Population (1941 census), 221,960.

WINTERGREEN. Deep in the cool northern woods the dainty little wintergreen nestles, a tiny evergreen much prized for the peculiar aromatic oil secreted in its glossy leaves. Essence of wintergreen is a favorite flavoring agent in confections and in medicines.

This small trailing shrub has a stem from three to six inches high, and the delicate pinkish-white urn-shaped flowers are almost hidden by the oval leaves.

Scientific name, *Gaultheria procumbens*. The plant grows wild in the mountainous districts in southern Canada and northern United States, and in many parts of England. It is also known as the teaberry, checkerberry, boxberry, jersey tea, spiceberry, and ground holly. The name "wintergreen" is also popularly applied to various other genera of the family *Ericaceae*.

PASTIMES on KING WINTER'S PLAYGROUNDS

WINTER SPORTS. When the lakes and streams are frozen and snow lies deep on the hills and valleys, the season of winter sports is in full sway. With the first ice on the ponds the skaters turn out for one of the finest pastimes of the year—skating over the transparent surface through which one can look at the water plants and grasses growing on the bottom.

The sport of skating is at least a thousand years old and probably much older. There are references to it in many of the early books of continental Europe, and still earlier mention in the Norse sagas of Iceland. The first record of it in England was in the 12th century, when skates were made from the brisket bone of an ox and fastened by thongs to the sole of the skater's boot. The practice at that time was to move by means of an iron-shod stick repeatedly thrust into the ice. The next step in the evolution of skates was an iron runner fastened to a wooden frame, used in the 14th century. From early beginnings of that sort the modern steel-bladed skate was developed. Three styles are in common use today—the racing model which is 14 to 18 inches long, with a thin flat blade and a tubular steel frame; the hockey skate with a flat blade, somewhat shorter than the racing model; and the "rocker" which is used for general and fancy skating. The blade of the "rocker" instead of being flat is slightly convex, and permits the skater to turn sharply without lifting his skates from the ice.

Skating races and exhibitions of fancy skating form a part of most winter carnivals. Recently there has been a steady increase of interest in the art of fancy skating, which includes the performance of many intricate revolutions upon the ice. This graceful sport requires good balance, a sense of rhythm, and no little athletic ability.

An exhilarating pastime is made possible by the use of a small sail which the skater holds in his hands and shifts according to the course he wishes to follow. The same principles that hold good in boat sailing are used in skate sailing. An essential, of course, is a fairly large area of ice.

When the snow spreads its thick blanket over the ice, the lover of winter sports may be compelled to put away his skates, but he still will have plenty of opportunity for enjoyment in the open. On his snowshoes he can tramp across fields and over the hills into the forest, penetrating with ease regions where in the summer he would find the going extremely difficult.

The northern Indians were the first to make use of snowshoes, which they found a necessity in winter traveling. Probably the first snowshoe was a thick little fir tree which some ingenious red man tied to his feet. No one knows when the snowshoe with a wooden frame and a webbing made from strips of skin was invented. The modern snowshoes differ in no way so far as design is concerned from the snowshoes that the Indians were using when white men first came to America. Some of the racing shoes used in Alaska are more than seven feet long. The opposite of that type is the "bear paw," a short round shoe about two feet in length, used mostly for travel in thick woods or in brush. The snowshoe in most common use is oval, with a tail a foot or two in length. The frame is

usually of straight-grained ash, and the filling is of strips of cowhide or caribou hide. There are two cross-pieces—one at the end near the tail and one at the widest point of the shoe, just above the opening into which the toe fits.

The shoe is fastened to the foot by means of thongs or by a contrivance so adjusted that the back of the foot rises and falls freely as if the sole of the foot were hinged to the webbing at the rear edge of the toe opening. The adjustment should always be such that the tail of the snowshoe drags and is not raised when a step is taken. For a person who weighs from 125 to 150 pounds a snowshoe 4 feet long and from 12 to 14 inches wide at the point of greatest width is of good proportions. Either leather moccasins or flat-soled boots of rubber with leather tops, with at least two pairs of woolen stockings, are the proper footwear.

EASY TO LEARN

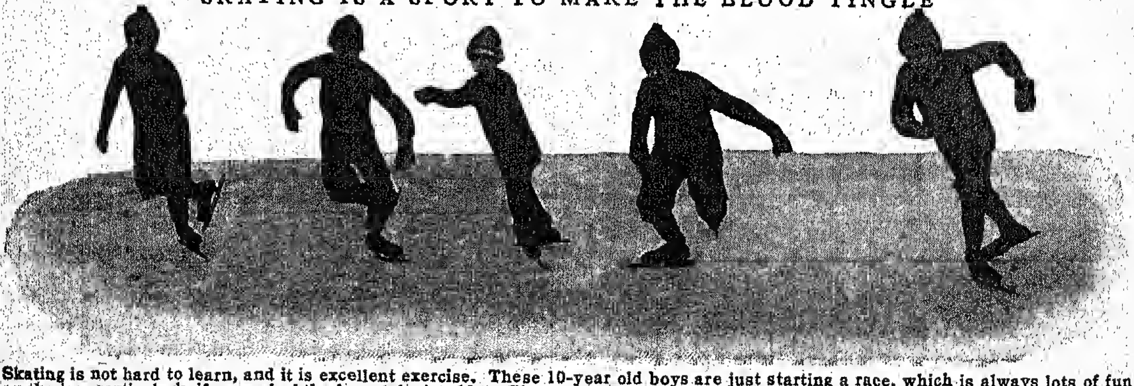
Snowshoeing is great fun for people of every age, and it is so easy to learn that even a little miss like this one can get around quickly after an hour or two of practice.

An hour's practice will enable the beginner to master the use of snowshoes for ordinary tramping, though of course he will not become an expert until he has covered a great many miles on the "raquettes," as they are sometimes called in the North. Running, jumping, sliding, turning quickly, and climbing are accomplishments that will come gradually to the enthusiastic snowshoer. The great advantage of the sport is that it enables a person to go almost anywhere across country, and to discover the real beauties of the winter landscape.

The ski originated, it is said, in Norway, and in fact it is often called the Norwegian snowshoe. On these long wooden runners one can go swooping down hillsides and across the open stretches of meadow and field at so swift a pace that it seems almost like flying. Their advantage over the Indian snowshoes is in their speed. Their disadvantage is that they are not so well adapted to use in the woods or in country where there is much brush. Skis should be of such length that when you place them on end you can touch their tips with your upstretched hand. For a person $5\frac{1}{2}$ feet tall that would mean a length of 7 feet or a little less. Usually they are between 4 and 5 inches wide. The equipment that goes with the skis includes heavy boots with heels, a harness to keep the foot in place on the runner and usually two sticks a little more than waist high with disks a few inches from the points to keep them from penetrating the snow too deeply. The ski is squared off at the heel and turned up at the toe, and is a little thicker at the center than it is at the ends. It should be made of wood that has a straight grain running parallel from end to end.

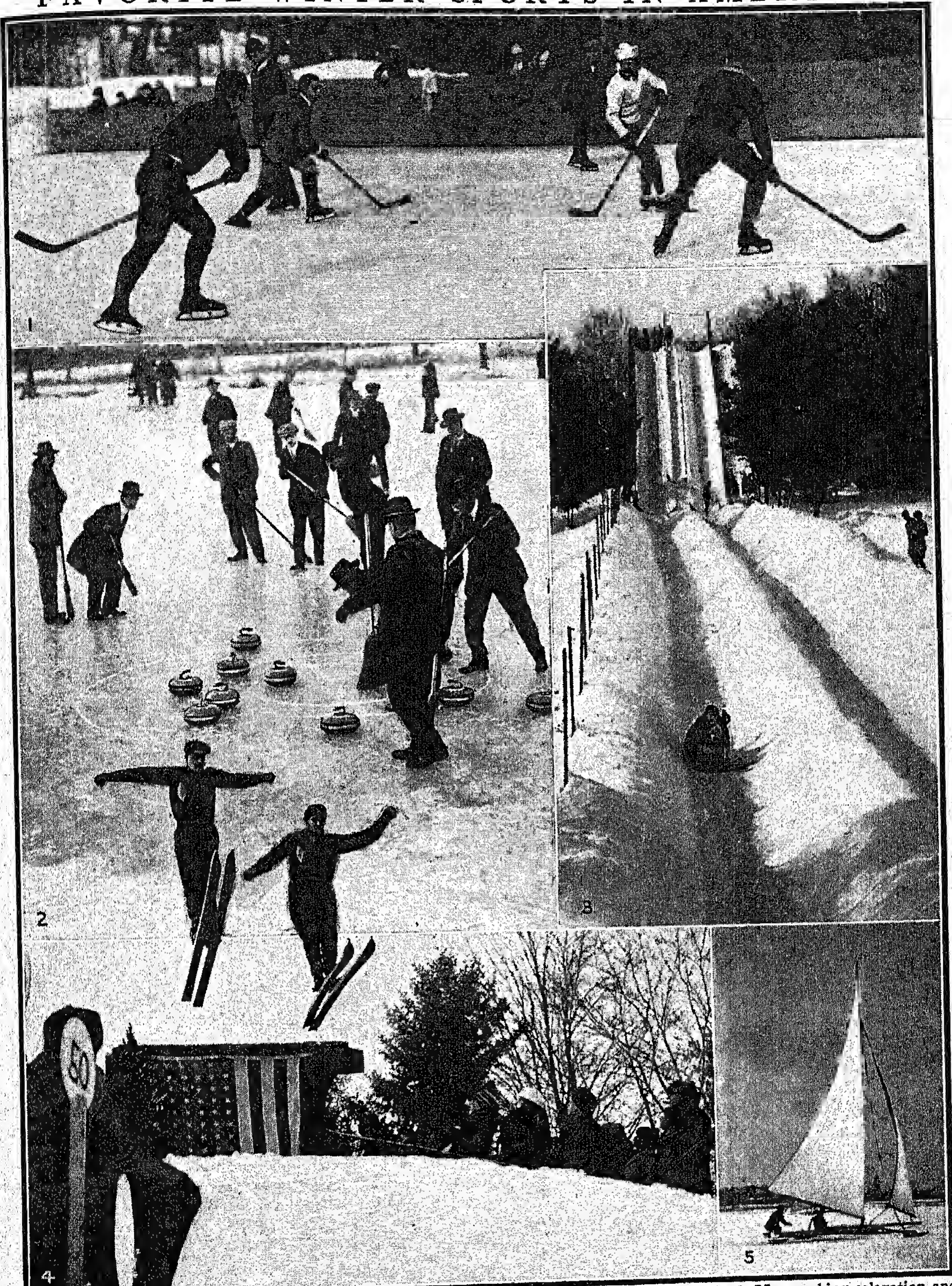
For many years skiing has been a favorite sport on the continent of Europe. In Switzerland it has always been a part of the winter carnivals that take place in the Alps, and the brilliant displays of the ski jumpers, who go shooting down the mountain sides, taking prodigious leaps of sometimes more than 100 feet, always attract the crowds of holiday makers. In Norway and Sweden skiing is the great national sport, and each year there are important meets to which runners are sent from the villages as competitors for the various championships. In the United States and Canada skiing is gaining in popularity every season. Some of the colleges maintain outing clubs which arrange for cross-country ski trips, and for an annual carnival much like the gatherings that take place among the Alps; and there are many places in the mountains of the northern states where during the holidays the inns and camps are crowded with people who have come to enjoy the winter sports. Young Americans in search of an exhilarating pastime can choose nothing more satisfying than ski running. Gliding down hills at high speed, running across country, and taking the lesser and greater jumps—each offers a separate thrill.

SKATING IS A SPORT TO MAKE THE BLOOD TINGLE



Skating is not hard to learn, and it is excellent exercise. These 10-year old boys are just starting a race, which is always lots of fun on the ice, particularly if several of the boys take tumbles. There are many games which can be played on ice once you have learned to skate easily.

FAVORITE WINTER SPORTS IN AMERICA



In every section where there is real freezing weather one or all of these sports can be enjoyed. 1. Men seeking relaxation and exercise in a game of Ice Hockey. 2. Curling, a game of Scottish origin, but now popular in Canada and parts of the United States. 3. Tobogganing, a thrilling sport, with first a sharp drop on a wooden slide, followed by a long "coast" down the slope of a hill. 4. Skiing, perhaps the most difficult of all winter sports. 5. Ice-boating, which requires considerable skill.

For a swift flight over hard packed snow, tobogganing offers sport that is almost as satisfying as skiing. The Indians were the first to use the toboggan, the name of which goes back to the Algonquin word *odabaggan*. The red men probably first used the toboggan for carrying their loads of food and supplies through the winter woods, but we may be sure that the Indian children soon took advantage of the toboggan for sport on the hillsides. The boys and girls of the northern tribes made the most of their opportunities in the winter time. They devised many snow games and undoubtedly found the same pleasure in the swift flight of a toboggan downhill that boys and girls do today who coast on their sleds and bob-sleds.

The Toboggan and the Bob-Sled

Toboggans vary in length from "single seaters" of four feet to 16- or 20-footers upon which a dozen persons may sit. They are made of long thin boards with the forward end curved upward. The steersman lies at the rear and guides the toboggan by his trailing feet. On the artificial slides made by scooping out a channel in the snow and banking the sides, or by building a trough of wood and filling the bottom with snow, there is little or no need of steering, for the toboggan remains within the narrow channel as it slips swiftly downward. Perhaps the most famous toboggan slide in the world is the one at St. Moritz, in the Swiss Alps, where people gather from all over the world to share the sport.

Bob-sleds or double runners are made by placing a long narrow platform above two single sleds. The person who sits at the front steers by placing his feet on a cross bar attached to the front sled or by two ropes fastened to the points of the forward runners. Little sleds and big sleds go down the hard packed roads that wind over the wintry hillsides. It is a sport that well repays one for the hard climb that comes after the swift flight to the bottom.

Sailing on the Ice

The winter pastime which requires the most elaborate equipment is ice boating or ice yachting, which has been an organized sport in the United States for 60 years or more. There are many places from Maine to the Rocky Mountains where the tall sails of ice boats are seen. On lakes and rivers of the northern states many followers of the sport get out their boats as soon as the ice forms. It is difficult to say when the first ice boat was made. Probably some ingenious boy placed runners on the bottom of a box, rigged a crude mast, and raised a blanket sail. From that small beginning by gradual steps ice boats have developed until now some of them weigh 3,000 pounds and carry 800 square feet of sail. In the most common form of ice boat a center timber forms the hull. To this is attached the "cockpit," in which sit the steersman and the passengers; at right angles is the plank on the ends of which are the runners. A third runner at the rear of the boat acts as a rudder. The mast is "stepped" upon a plate fastened to the center timber, just forward of the cross-plank. The two-sail rig—"jib" and "mainsail"—is the one in most common use, and of course the principles of handling are similar to those of water sailing. The speed that may be attained in a well-built ice boat with a large spread of sail is very high. It is said that the sail boats along the Hudson River often race the express trains which are speeding along on shore.

There is another form of ice craft, called a "scooter," which is really nothing more than a sailing skiff with runners on the bottom. It can travel over ice or through open water and can lift itself from the water to the ice with the power of the wind behind it. It was invented by fishermen who found it a convenient means of crossing partly frozen rivers and bays.

Though ice boating requires a more elaborate equipment than most of the other winter sports, this is to be said for it—that it is not difficult for an ingenious boy to construct his own boat, and he can do it at small cost. His homemade affair may not be as swift or as graceful as the expensive professionally made ice boat, but he may confidently count upon it to give him many hours of fascinating sport.

'WINTER'S TALE'. The King of Bohemia is revealed, in this romantic drama by Shakespeare, as a guest at the court of Leontes, king of Sicilia (Sicily), enjoying such hospitality from Queen Hermione that Leontes is seized with fierce jealousy. He forces the Bohemian guest to flee for his life, throws the queen into prison, and commands that her new-born babe, a girl, be carried to some foreign shore and left to die. He then summons Hermione to trial. To his confusion, an oracle from the god Apollo at Delphi declares that "Hermione is chaste, Leontes a jealous tyrant, and the King shall live without an heir if that which is lost is not found." Almost immediately, word is brought that the young Prince of Sicily, Leontes' heir, is dead of grief; and Hermione, until now dignified and firm in her sufferings, falls down as if she too were dead.

For sixteen years Leontes lives a remorseful life, bereft of wife and children. Then there arrives at his court a pair of runaway lovers, who prove to be the King of Bohemia's son, Prince Florizel, and his exquisite bride, the daughter of a shepherd of Bohemia. The Bohemian king follows hotly after. In fear of the king's rage, the old shepherd who has accompanied the fleeing lovers produces a jeweled chain and a letter that prove Florizel's bride to be, not the shepherd's daughter, but Perdita, the lost princess of Sicilia! One of the ladies of the court now invites the company to view a wondrous statue. As they gaze in admiration the "statue" comes to life, being indeed the injured and long-concealed Hermione, who, recovering from her faint, has lived in seclusion until the oracle should be fulfilled and Perdita found.

The prettiest incident in the play is that of the wooing between Prince Florizel and his "shepherdess." For the festivities of the sheep-shearing he has donned shepherd's clothes and thus obscured his rank, and has so decked out Perdita that she seems not a

shepherdess but some fairy queen, whom he addresses in these words—

What you do
Still betters what is done. When you speak, sweet,
I'd have you do it ever: when you sing,
I'd have you buy and sell so; so give alms;
Pray so; and, for the ordering of your affairs,
To sing them too: when you do dance, I wish you
A wave o' the sea, that you might ever do
Nothing but that; move still, still so, and own
No other function. Each your doing is
So singular in each particular,
Crowning what you have done i' the present deed,
That all your acts are queens.

An interesting minor character is the light-hearted and light-fingered peddler, Autolycus, who "having flown over many knavish professions" has "settled only in rogue." He appears at the sheep-shearing singing his wares:

Lawn as white as driven snow;
Cyprus black as e'er was crow;
Gloves as sweet as damask roses;
Masks for faces and for noses;
Bugle-bracelet, necklace-amber;
Perfume for a lady's chamber;
Golden quoifs and stomachers,
For my lads to give their dears;
Pins and poking-sticks of steel;
What maids lack from head to heel:
Come buy of me, come; come buy, come buy;
Buy, lads, or else your lasses cry:
Come buy.

WINTHROP, JOHN (1588–1649). Because he feared that the "talents which God hath bestowed upon him for public service are like to be buried" if he remained in England, the Puritan, John Winthrop, crossed the Atlantic in 1630 as governor of the Massachusetts Bay Colony. To him the city of Boston owes its foundation, and except for brief intervals he served as governor of the infant colony until his death.

Winthrop had belonged to the landed gentry of England. He had been educated at Cambridge University, had read law, and had become an office-holder for a time. But the arbitrary rule of Charles I and the religious intolerance of Archbishop Laud had driven him from office and from home. The ideas of the man of his class, however, remained with him even in the new country. He speaks, for instance, in his 'History of New England' of the "commons" and the "meaner sort." He had a dread of "meer democracy" which came near to proving his undoing.

The people of Massachusetts Bay tired for a time of Governor Winthrop's arbitrary rule, and in 1634 they dropped him from the office which he had held for four years. Regardless of the fact that at four different times Winthrop was out of office, he continued to work zealously for the good of the colony. In 1643 he led in founding the New England Confederation, and he was elected its first president. He was a mild even-tempered man who reasoned out his course of action, and his decisions frequently saved the colony from Indian massacres and from interference by the English government. Even after his death his influence was a potent factor in the development of the colony.

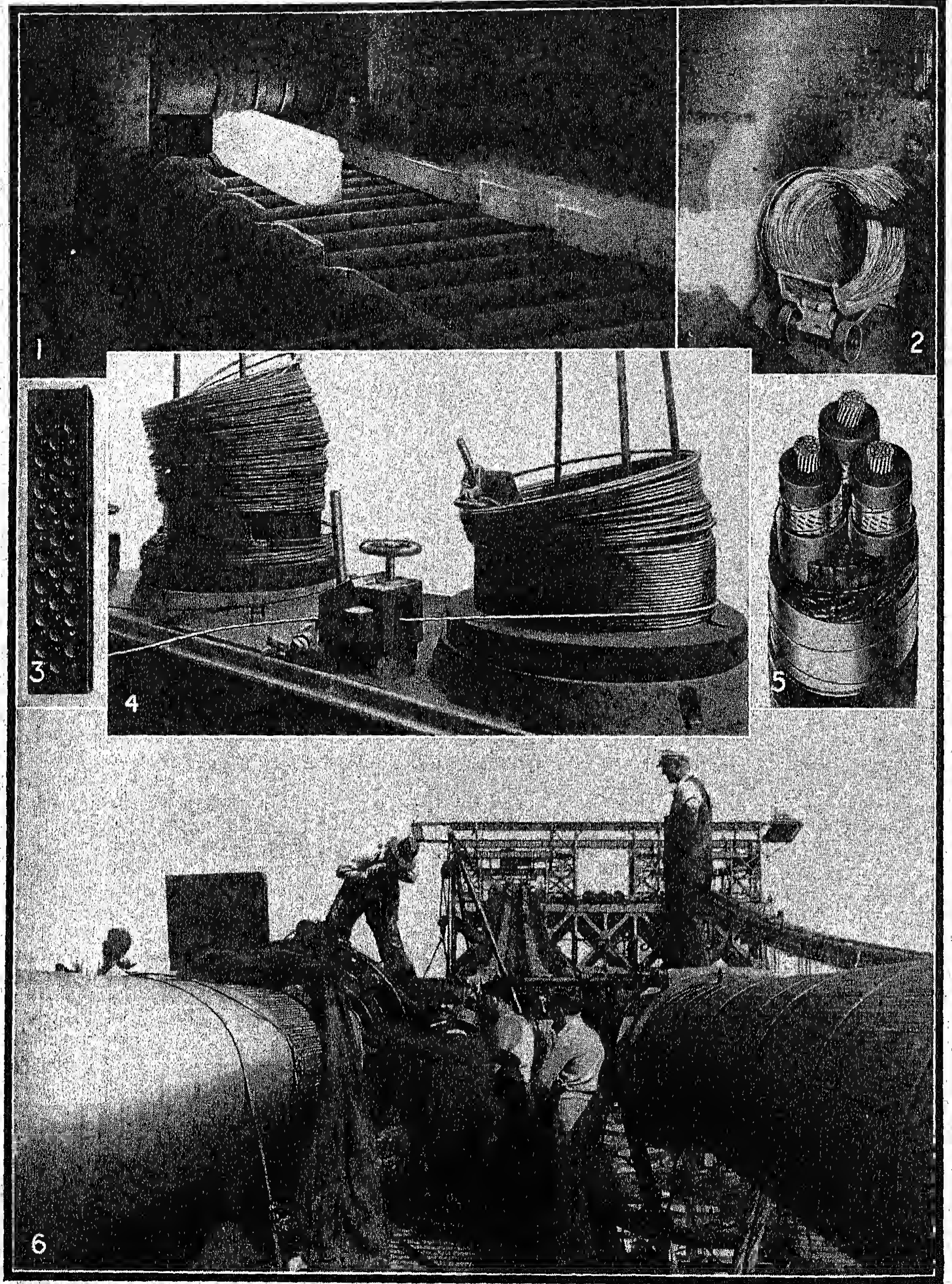
WIRE. When you wake up in the morning rested after a good night's sleep, perhaps it does not occur to you that one of the chief reasons for your comfortable slumber is the fine wire network of the bedsprings on which your mattress rests. You look at your watch to see the time; the hairspring of the mechanism is made of the finest tempered and flattened wire. You may use a brush of fine wire to wash your hands and another to comb your hair. If it is dark, the electric light which you turn on is charged with power transmitted to you over steel and copper wires. Perhaps before you leave home you wish to use the telephone. Again thousands of miles of wire are at your service. Perhaps the fence that surrounds your home is made of woven steel wire. The street car which takes you to school or to work gets its power from the heavily charged trolley wires overhead. Or if you ride in an automobile or on a bicycle, wire entered into the composition of the spokes and springs, and the bridge you cross may suspend from cables of wire. Every time you use a pin or needle or drive a nail, the wire industry supplies you with the instrument. Heavy cables, which are simply a number of wires twisted together, haul you up and down in elevators. The sound from the piano whose music you may enjoy is largely the result of vibrations of finely attuned wires inside the instrument.

So you conclude, and justly, that the improvement in the manufacture of wire is one of the greatest steps forward that industry has taken in the last century. Perhaps it might not be too much to say that many of the most wonderful inventions of our age could never have reached their present high efficiency had it not been for the discovery of the method of making machine-drawn wire less than a century ago. The old methods of hammering the metal, and drawing it into wire were both laborious and cumbersome in comparison to modern practice.

The commonest wires used are made of steel or copper or alloys of both. Several other metals are used, however, the most common ones being nickel, platinum, silver, iron, aluminum, and gold. Metals used for wire must be capable of being drawn out (ductile) and of sustaining weight or bending without snapping. Gold, silver, and platinum lead the other metals in ductility; a grain-weight of gold has been drawn into a wire one fifty-thousandth of an inch thick which reached more than a mile. Wires such as these are used as spider-lines for telescopes and in the manufacture of scientific instruments of the most delicate accuracy.

Wire has been in use for many hundreds of years. It was known in Nineveh and Egypt in 800 B.C. It was made then and for many centuries afterward by beating metal into plates which were then cut into strips and rounded by further beating. Wire drawing was known in the 14th century, but the machinery used in this process and the Bessemer steel were not perfected until the last century. In modern wire plants the raw material, usually steel, is received in

HOW WIRE IS MADE AND SOME OF ITS USES



1. A white-hot steel billet is starting through the rollers that will reduce it to thin rods. 2. A coil of rods is going into the chemical bath that prepares it for drawing. 3. One of the dies used for heavy wire. 4. The rod is drawn through the die by large revolving drums. 5. The aristocrat of wires, an armored electric cable, protected by rubber, lead, and coiled steel tapes covered with asphalted jute. 6. How small wires are compacted into a cable to support the great George Washington Bridge, New York City.

the form of small bars or billets. The billets are heated and conveyed to a set of rolls to be reduced in size. Finally, for ordinary sizes of wire, the billet is rolled down to a rod smaller than a lead pencil. The heated rod is carried through a pipe to a coiling device which coils the rod. The coiled metal is cooled and taken to the drawing plant where it is drawn into wire of all sizes. First the scale which has accumulated is removed by an acid bath and the acid removed in an alkali bath. Next the rod with its point made small enough enters a bell-mouthed hole in a draw plate or die made of hard steel or, in some cases, of a diamond or ruby, and emerges from the smaller end of the hole reduced in size. The process of drawing the wire through smaller and smaller holes continues until the desired size is reached. As the metal is drawn finer it becomes harder and more brittle, so that from time to time it must be annealed to make it soft and tough and it must be constantly oiled as it is drawn through the dies or perforated plates.

How the Dies Are Made

Small wire of iron, steel, or alloy steel often is drawn through diamond dies with holes ranging from 0.040 to 0.002 inch in diameter, sometimes passing through as many as 12 dies in one draw. The dies are made of bort diamond, an 0.040 inch wire requiring a diamond of some $3\frac{1}{2}$ carats. A die used to draw steel wire may last only three days. Dies for drawing copper wire are usually made of chilled steel, and last about a year before they become too large. Diamond dies are made originally with holes of 0.002 inch, which are re-drilled as occasion demands until they are too large for further use. Only about 15 pounds of steel wire may be drawn through the smallest die before it must be re-drilled.

Larger wire goes into the high-grade spring steel coils used in most internal combustion engines to close the valves. Still larger wire forms the bracing rods in airplane wings and fuselages. Enormous quantities of special heat-resisting wire are used as the center wire electrodes of spark plugs. Electric irons, percolators, and other appliances employ resistance wire in their heating elements. Most such wire contains nickel or chromium (*see* Alloys).

Electricity is carried over far-flung high-tension transmission lines on wires of aluminum containing steel centers which carry the weight of the wires and the strain imposed by winds. In many machine shops accurately drawn steel wire is used in precision measurements of screw thread diameters.

Dredges, steam shovels, derricks, cranes, ships, and tugboats use wire hawsers or cables, usually much larger than elevator cables. These are twisted around hemp cores, layer on layer, each composed of many strands of small wire. In many powerhouses wire rope is used to carry power from engines to machinery.

Huge suspension bridges depend on giant wire cables to carry the load. These are remarkable for their enormous size, and because they are usually manufactured right on the job.

Many miles of wire are used in making a single naval gun; the wire is wrapped under great tension around and around the barrel.

Barbed wire is an American invention credited to Lucien B. Smith and William B. Hunt. It has contributed enormously to the agricultural development of the western part of the United States where vast acreage made protection of crops and live stock virtually impossible. Machinery for the rapid production of barbed wire was devised in 1874 by Joseph F. Glidden and Phineas W. Vaughan. The typical barbed-wire machine of the present uses four reels of wire, each feeding one strand into the machine. Two of these strands run side by side and become the body of the finished wire. The others are run across one of these strand wires. At intervals the machine cuts a length from them, twists the lengths around the strand wire, and cuts points on them. After the strand wires pass the point where this is done, they enter machinery which twists them about each other. Once started, the operation of the machine is continuous, so long as wire is fed to it. If additional barbs are wanted, as in military barbed wire, additional cross-wires and machinery are used.

Barbed Wire and Its Uses

The use of barbed wire as a defense against attack in war has been a remarkable modern development. Wire defenses were used extensively by General Weyler against the Cubans, and later against the Americans in the Spanish-American War. Russian and Japanese commanders also constructed barbed wire defenses, as did the Boers in their war against Great Britain. But the full development of barbed wire entanglements as defense did not come until the World War of 1914–1918, in which the various combatants are said to have used more than a million miles of barbed wire.

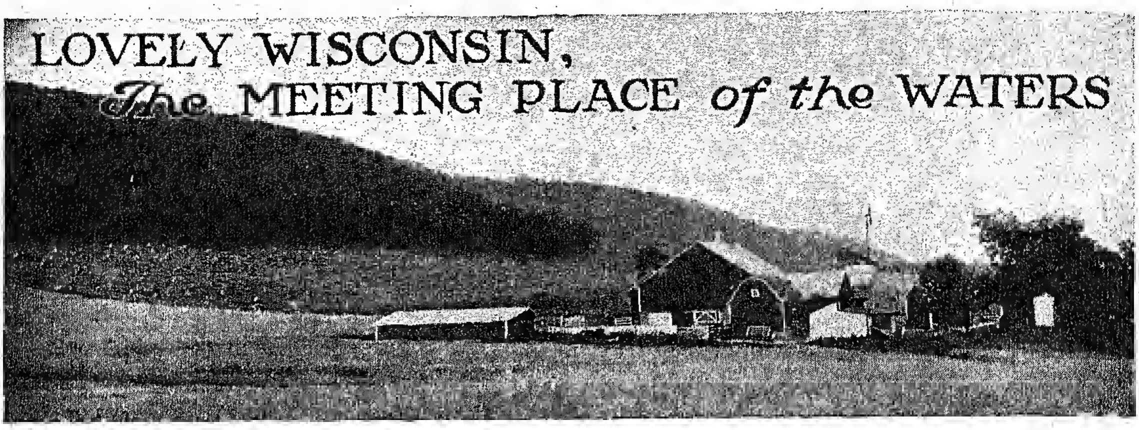
Steel wire and wire net have come into wide use in recent years as one of the materials to reinforce concrete for roadways and in buildings.

Insulation of wires for carrying electricity has become an industry in itself. Rubber, silk, cotton, jute, and paper are the substances most commonly used as insulators. The fiber insulation is wrapped spirally and protected by paraffin or some other preservative.

There are several systems of wire sizes or "gauges," the Brown and Sharpe, or American, being used largely for copper and alloy wires, and the American Steel and Wire Company gauges for iron and steel wires. In the Brown and Sharpe system No. 1 wire is 0.28930 of an inch in diameter; the largest, No. 000000, is 0.58 of an inch, and the smallest, No. 50, is 0.00088 of an inch in diameter. The American Steel and Wire Company's "music wire" gauge increases in size for the larger numbers, No. 1 for example, being 0.01 of an inch in diameter and No. 45 being 0.18 of an inch.

WIRELESS. In the early days of communication across "empty" space by means of electrically generated waves, the process was called wireless, since that word emphasized spectacularly the contrast with the older "wired" devices. Today the term has been almost entirely replaced by the word "radio" (*see* Radio).

LOVELY WISCONSIN, The MEETING PLACE of the WATERS



Extent.—North to south, 320 miles; east to west, 295 miles. Area, excluding 10,062 square miles Great Lakes water surface, 56,154 square miles. Population (1940 census), 3,137,587.

Natural Features.—An undulating plain, rising to 1,940 feet above sea level in north central portion (Rib Hill, near Wausau), and thence sloping to Lake Superior, the Mississippi River, and Lake Michigan; southern half diagonally intersected by a valley containing Green Bay, Lake Winnebago, and the lower Fox and lower Wisconsin rivers. Principal rivers: Wisconsin, Fox, Chippewa, Black, and St. Croix. More than 2,000 lakes, mostly in glaciated north and east; Winnebago the largest. Mean annual temperature, 44°; mean annual precipitation, 30".

Products.—Corn, hay, oats, barley, rye, potatoes, cranberries, hogs, cattle, poultry and eggs; dairy products, automobiles, foundry and machine products, furniture, lumber products, paper, leather, knit goods, clothing, meat packing, iron and steel, rubber goods, shoes; briquets, stone, zinc, lead, lime, iron, mineral waters.

Cities.—Milwaukee (587,472), Madison (capital, 67,447), Racine (67,195); Kenosha, Green Bay, La Crosse, Sheboygan, Oshkosh, West Allis, Superior, Eau Claire, Appleton, Wauwatosa, Wausau, Fond du Lac, Beloit, Manitowoc, Janesville (over 20,000).

WISCONSIN. A green forest wilderness and a portage trail was the Wisconsin that Jean Nicolet found when, seeking distant China, he steered his birch-bark canoe into Green Bay in 1634. The Wisconsin of today, with its thousands on thousands of well-tilled farms and its scores of busy industrial towns, still has enough of the green forest left, especially in the beautiful northern lake region swarming with wild fish and fowl, to make an enchanting summer paradise for the jaded city dweller. Civilization and wilderness are neighbors.

Wisconsin slopes into three main drainage basins. To the north it falls abruptly into Lake Superior; to the south and west it inclines gently, with a long slow slope, toward the Mississippi; to the south and southeast it drains by shorter slopes into Lake Michigan. Diagonally across the state from northeast to southwest runs a broad shallow valley, the water trough of Green Bay, the Fox River, Lake Winnebago, and the Wisconsin River.

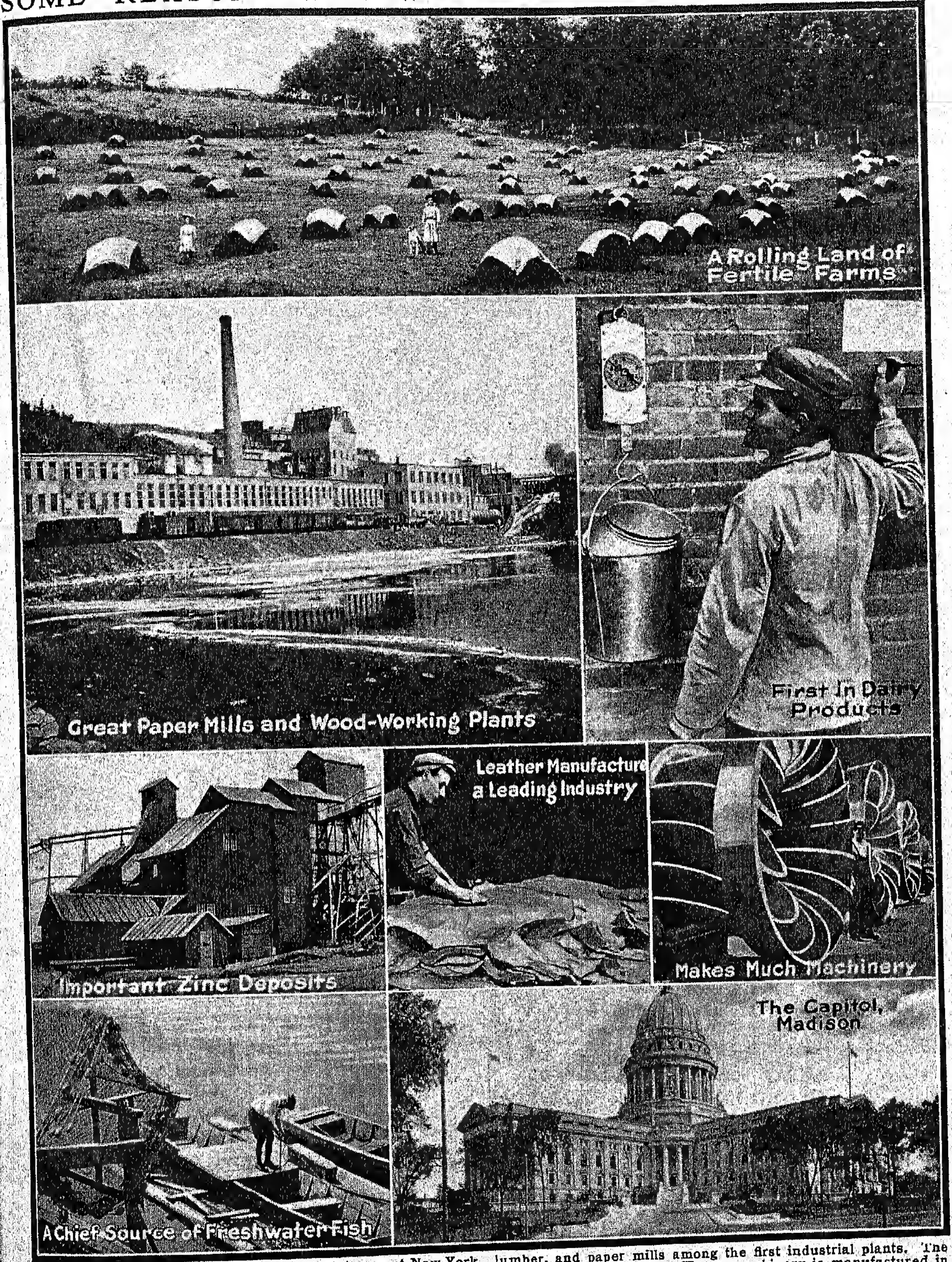
Chief Occupations

The tradition that the mysterious Indian name Wisconsin means "meeting place of the waters" is, if not true, at any rate nicely invented; for here, in the Fox-Wisconsin valley, navigable waters flowing into the Mississippi are only a mile and a half from waters entering the Great Lakes. The main route of exploration and early trade was through this valley, with a portage across the narrow watershed at the point where the city of Portage now stands. This was also the favorite of the French among all the routes from the Great Lakes to the Mississippi, which made Wisconsin valuable to France, not merely as a highway of the fur trade, but even more as the link between the two halves of her western empire, Canada and Louisiana. The French and Indian names on the map of Wisconsin are almost the only remaining memorials to the two races that once used this valley route, now abandoned as a main highway of commerce but risen to new importance in industry. The majority of the state's leading manufacturing cities are in the southeastern triangle defined across the state by the Fox-Wisconsin valley. More than half of Wisconsin's manufactures come from this highly industrialized region.

It is an ancient land, this Wisconsin, born when the world was young. Here and there pages of its history can be read in rocks so old as to make the Egyptian hieroglyphs seem as new as yesterday's newspapers. Here, for instance, is the granite backbone of the north-central part of Wisconsin, one of the first parts of the North American continent to emerge, a lofty mountainous island, from the primeval sea, while at its foot grew coral reefs to make the limestone foundations of the southern part of the state. Later we can read how nearly the whole of the state lay buried beneath the flooding glaciers of the Ice Age. And now the glaciers, after many a hesitating advance and retreat, have flung down their loads of earth and rock and gone forever, and we begin to see the features of the Wisconsin of today.

In the driftless area of the southwest, the drainage basin of the Mississippi, the deep wrinkles and rugged bluffs made by preglacial drainage and erosion still furrow the earth, but the ruggedness of all the rest of the state has been softened by a thin layer of fertile glacial drift which, it has been estimated, is worth $30,000,000 a year to Wisconsin

SOME REASONS WHY WISCONSIN KEEPS GROWING



Wisconsin raises more hay than any other state except New York. It uses this crop for the winter feeding of dairy cattle, in which Wisconsin leads the nation. Wisconsin is also first in the production of cheese and of condensed and evaporated milk. Abundant water power and great forests brought wood-working, lumber, and paper mills among the first industrial plants. The lumber is now imported. Heavy machinery is manufactured in Milwaukee, Racine, and Kenosha. Leather manufacturers who once used native hides, now import both hides and tanning materials. Commercial and pleasure fishing is also important.

farmers. The characteristic beauty and interest of the scenery of this part of Wisconsin are due also to glacial souvenirs—moraines, and the many lakes gouged out by the moving ice sheet. These lakes are popular vacation resorts. The Four Lakes (Mendota, Monona, Waubesa, Kegonsa), near Madison, have been celebrated by Longfellow in verse:

Four limpid lakes—
four Naiades
Or sylvan deities are
these
In flowing robes of
azure dressed;
Four lovely hand-
maids, that uphold
Their shining mirrors,
rimmed with gold
To the fair city in the
west.

Thin glacial soils, cool summers, and irregular topography limit the crops which can be produced most profitably. The German and Scandinavian farmers who settled Wisconsin were experienced in the care of live stock, and so they early turned to dairying. Today Wisconsin is the most important dairy state in the country. Hay, in which the state ranks second to New York, is the most valuable field crop. Corn, oats, barley, potatoes, rye, tobacco for cigar binders, flax, hemp, cranberries, and sugar beets are also raised. The Door peninsula, between Green Bay and Lake Michigan, is a great cherry and apple orchard.

GEOGRAPHY OF THE "BADGER STATE"

How Science Aids the Farmer

The state's agricultural success is due largely to the College of Agriculture and the Wisconsin Agricultural Experiment Station, which are units of the state university at Madison. The Experiment Station discovers facts; the College of Agriculture passes them on to the farmers through its extension division and its resident students. In the Experiment Station Dr. Stephen M. Babcock originated the Babcock test for butter fat in milk which made commercial dairying possible (*see* Dairying). New methods of curing and packing cheese and of pasteurizing milk, improved strains of barley, rye, alfalfa, corn, and wheat, and improved methods of cranberry culture add millions of dollars annually to the state's wealth.

Wisconsin's earliest industry, fur trading, is still profitable. Scientific fur farming has replaced trapping. Fur-bearing animals are studied at the state experimental game and fur farm at Poynette.

Timber and Mineral Resources

In the early years of the 20th century Wisconsin was the leading lumber state, famous for its white pine. Most of the virgin forest has disappeared, leaving cut-over and burned timberland unsuited to agriculture. Under zoning laws which permit counties to determine the most profitable use of their land, poverty-stricken farms are being acquired by purchase and tax delinquencies. Their owners are being settled elsewhere and the land reforested. In addition to the county forests, there are many thousands of acres in state and national forests.

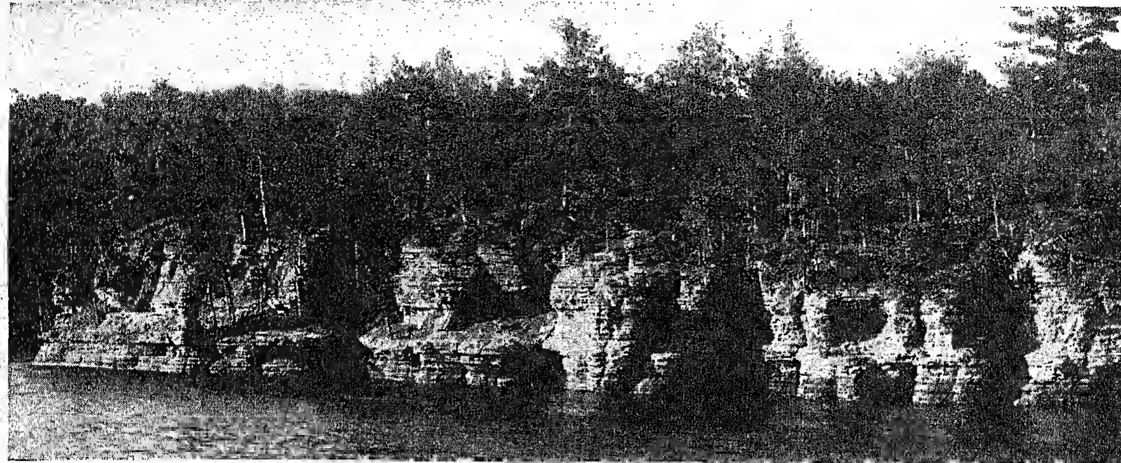
Lead mining was once an important industry in the southwestern part of the state, but zinc is now the more valuable mineral there. Iron comes from the Penokee-Gogebic Range, in the Lake Superior ore district. Stone, gravel, sand, and clay are found throughout the state. In the value of mineral water, which is bottled chiefly at Waukesha, Wisconsin leads all the states.

A chief factor in the state's manufacturing prominence is the economical transportation afforded by the Great Lakes. Although there is little coal, water power is abundant, and coal can be cheaply shipped in from other Great Lakes states.

Industries Based on Natural Resources

The leading dairy state in the country, Wisconsin is also first in the manufacture of cheese and condensed and evaporated milk. It is among the leaders in the production of butter. The wood-using industries, which were among the earliest to be developed, now have to import much of their raw material. In the manufacture of pulp and paper the state usually ranks second in the country. Lumber and furniture are also important. The university and the United States Forest Service coöperate in maintaining a forest products laboratory in Madison, where experts develop new uses for the nation's timber. Leather

IN THE "DELLS" OF THE WISCONSIN RIVER



When glaciers moved down over Wisconsin, they dammed the Wisconsin River and filled its bed with debris. After the ice retreated, the river found a new course some miles to the west, across a ridge of soft sandstone near the present city of Wisconsin Dells. The narrow and beautifully eroded gorge which it has carved through this ridge is known as the "Dells," from the French word *dalles*, meaning "slabs." A few miles south, near Baraboo, is scenic Devils Lake, which lies in a gorge cut by the pre-glacial river and dammed at both ends by the glaciers. Both regions are popular tourist resorts.

manufactures were originally based on domestic hides and native tanning woods. Now most of the hides and the chromite used to tan them are imported from foreign countries. Agricultural implements, automobiles, and heavy machinery, such as cranes, turbines, and electrical, excavating, and road-building machinery, stand high on the long list of products. Meat-packing products, malt liquors, boots and shoes, clothing, and knit goods are other noteworthy items.

The Lake Michigan fisheries contribute about a million dollars a year to the state's wealth. The city of Green Bay is one of the leading fresh-water fishing centers of the world. But the pleasure fishing which attracts thousands of summer tourists to the smaller lakes is many times more profitable.

People and Government

Immigration into the state increased rapidly after 1832 with the close of the Black Hawk War. New Englanders and New Yorkers, Scandinavians and Germans began to arrive. The year Wisconsin was admitted to statehood, in 1848, the German immigration became a flood. Denied a voice in their own government by the defeat of a popular liberal movement, the Germans turned to Wisconsin. Here foreigners who intended to become citizens were allowed to vote and hold public office after one year's residence. The southeastern part of the state became a new Germany. In the northwest, Scandinavians predominate.

These people brought to their new home a tradition of independence and individualism on the one hand, and of coöperation and regulation on the other. They were among the first in the country to organize farmers' coöperatives. They fought to regulate the rates of railroads and public utilities. They pioneered in the direct primary, workmen's compensation, taxation on incomes, civil service reform, and unemployment insurance. Theodore Roosevelt declared that "the state has become literally a laboratory for wise experimental legislation aiming to secure the social and political betterment of the people as a whole." The university played an important part in this program. Its experts drafted laws and served on the numerous commissions appointed to administer those laws—such commissions as the public utilities, tax, civil service, insurance, industrial, conservation, and highway commissions. A Legislative Reference Library—the first in the country—headed by Charles McCarthy, was founded to give the legislature technical assistance.

The "Wisconsin Idea" sought to achieve a better use of government for the good of society through the coöperation of state legislature and state university. Under the vigorous leadership of Robert M. La-Follette, governor and for many years United States senator, the idea was developed. Working with him were such men as John Bascom, president of the university during the vital years of its growth, and the economists John R. Commons and Richard T. Ely.

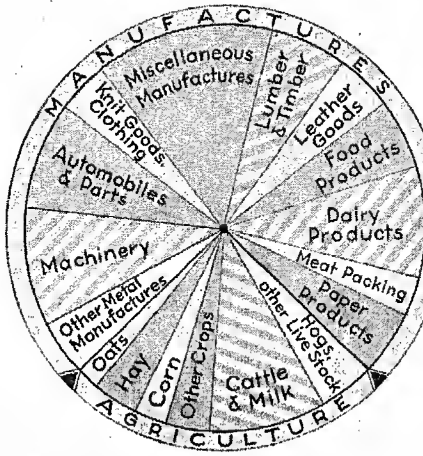
A more recent expression of the "Wisconsin Idea" is the Wisconsin Alumni Research Foundation. It was established by university alumni to administer the patent rights on the irradiation of foods with ultraviolet light, a process invented by Dr. Harry Steenbok of the university staff (*see* Radiation; Vitamins). Royalties paid by manufacturers who use the process are applied by the Foundation to further research.

The original constitution of 1848 is still in effect, with amendments. The governor and administrative officers of the state are elected by the people for two-year terms.

Cities and Their Products

Milwaukee is the chief industrial city (*see* Milwaukee). Racine, with one of the best harbors on Lake Michigan, carries on an extensive lumber and coal trade. It manufactures agricultural implements, malted milk, trunks, floor wax and polishes, radiators, and tools. Kenosha is also an important trade

center; it manufactures leather, automobiles, furniture, wagons, machinery, etc. Superior shares with Duluth, Minn., one of the finest inland natural harbors in the world and the commercial advantage of being the extreme western port of the Great Lakes system. It has many manufactures, shipyards, immense coal docks, grain elevators, and a large dry-dock. Madison, the capital, in addition to being the home of the University of Wisconsin and of a number of other educational institutions, is also a manufacturing center and a summer resort. Oshkosh, on beautiful Lake Winnebago, the largest lake in the state, is the seat of one of the largest state normal schools, and of factories for lumber and lumber products and a number of other important products. Green Bay is the oldest town in the state, and an important distributing as well as manufacturing center. Sheboygan is the shipping point for a farming and dairying region, with large cheese warehouses, many factories, large coal and salt docks, and important fishing interests. LaCrosse is the center of the farming and dairying region of western Wisconsin, southern Minnesota, and northeastern Iowa, with many important manufactures. Fond du Lac also is noted for dairy and agricultural products, and has a number of important manufactures. Beloit is the seat of Beloit College, of one of the largest woodworking machinery plants in the world, and other manufactures. Eau Claire is the commercial center of northwestern Wisconsin, and the outlet of the Chippewa lumber district. Appleton is the seat of Lawrence College and of extensive paper, pulp, farm implement, and other manufactures. Janesville is the tobacco center.



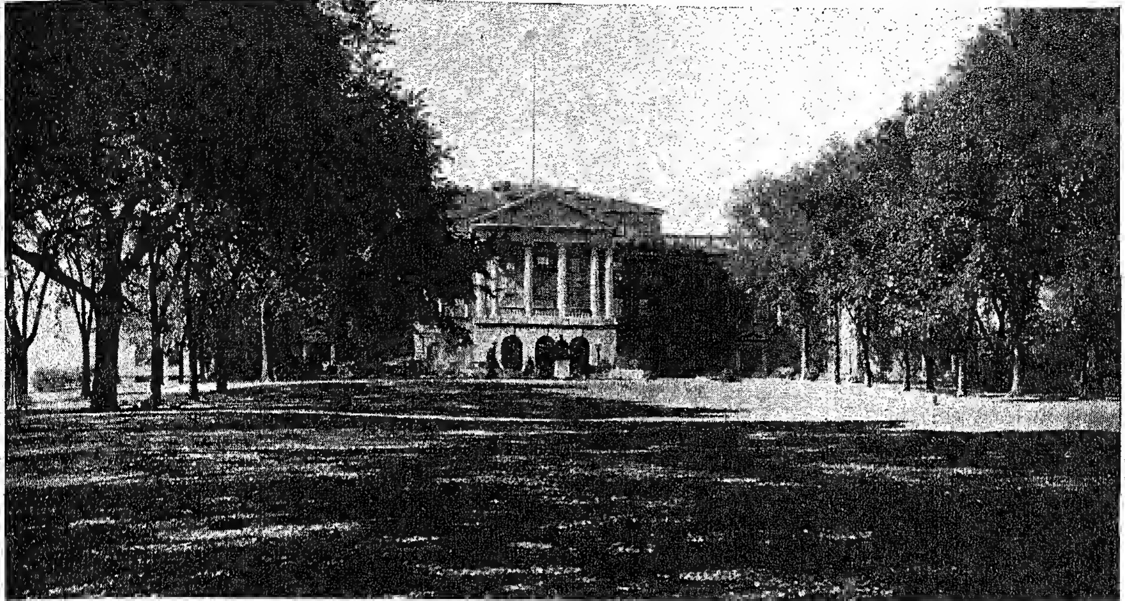
Relative Value of Wisconsin's Products

For centuries before the coming of the white man Wisconsin's beautiful woodlands, lakes, and rivers were favorite hunting-grounds and dwelling places for a large Indian population, as the many mounds and implements they left attest. Today the Indians number only about 14,000, confined almost entirely to reservations. The first white man to enter the region was probably Jean Nicolet, a French explorer sent out by Champlain. He landed near the present city of Green Bay in 1634 and traveled down the Fox River for a considerable distance. In 1658–59 two fur traders, Radisson and Groseilliers, followed the Fox-Wisconsin route perhaps as far as the Mississippi. The first permanent mission was founded by Father Claude Allouez in 1665 near Ashland, and four years later the first church was built by him on the site of DePere, where a trading settlement soon sprang up. Other famous missionary explorers followed, including Marquette and Joliet in 1673, and LaSalle in 1679.

This French trading and missionary activity left marks of its influence in the French names of many towns and some of the old families of the state. At the close of the French and Indian War in 1763, the region passed under the rule of Great Britain. Although Wisconsin was part of the territory ceded to the United States at the close of the American Revolution, the British did not evacuate the military posts there until 1796, owing to the disputes between the countries which John Jay was sent to England to settle in 1794 (*see* Jay, John). Until 1822, when the opening of the lead diggings in the southwestern part brought a rush of immigrants, growth was slow and fur trading remained the chief occupation. Treaties with the Indians between 1829 and 1833 extinguished the Indian title to vast areas of land and opened it to settlement; but the Black Hawk War (1831–32) for a time retarded immigration. A steady tide of immigration then set in from New England, New York, and other eastern states.

Wisconsin was the last state created out of the old Northwest Territory. As originally planned it would have taken in a strip of land west of the southern end of Lake Michigan which now includes Chicago, but Congress paid no attention to the request of the inhabitants of this tract. Wisconsin Territory as formed in 1836 was much larger than the present state, for it included the whole of Iowa and Minnesota and parts of the Dakotas. When Michigan was admitted as a state, in 1837, the "northern peninsula," which geographically is a part of Wisconsin, was given to Michigan to compensate that commonwealth for the loss of territory to Ohio in what is called the "Toledo War" (*see* Ohio). Wisconsin received its present limits in the enabling act passed by Congress in 1847 to admit it as a state; but the first constitution framed under that act was rejected by the people because of its "radical" provisions relating to the rights of married women, the election of judges, etc. Next year a more conservative constitution was approved by the people and the state was admitted to the Union (1848). That same year the unsuccessful revolutionary movement in Germany drove thousands of German liberals across the Atlantic, a large proportion of whom made their new homes in Wisconsin. Anti-slavery sentiment flourished in the young state, and in 1854 Ripon was the scene of one of the earliest of the movements which resulted in the organization of the Republican party. Wisconsin played a noteworthy part in the Civil War, furnishing to the Union more than its quota of men and several commanders of distinction; one-ninth of the state's total population served in the Union

BASCOM HALL TOPS "THE HILL" AT THE UNIVERSITY



Ivy-covered Bascom Hall looks down "the hill" past other state university buildings and arching elms towards Wisconsin's state capitol more than a mile away. On gala occasions students mass on the campus in front of Bascom, which has classrooms and administration offices. The University of Wisconsin, located on the west shore of Lake Mendota in Madison, was opened in 1849.

army. In the Spanish-American and World wars its record was no less creditable.

Wisconsin's nickname, the "Badger State," has a curious origin. The name "badgers" was originally applied to the lead-miners near the Illinois line in early days, because they lived in dugouts on the hillsides similar to the burrows that badgers make underground. Afterward the name was applied to the people of the whole state.

WISTAR'IA. The large drooping clusters of handsome flowers which are borne in great profusion by the wistaria make it one of the most attractive vines used in the covering of verandas and walls. It grows rapidly, often 20 feet in a season. The leaf is formed of from 9 to 15 oval leaflets, the flower resembles the sweet pea in shape, and the seeds or beans are found in long pods. The wistaria is a native of Japan, China, and North America. There are several varieties, among which are the *Wistaria frutescens*, a species belonging to the United States, and the Chinese variety *Wistaria chinensis*, a more showy plant. The latter blooms earlier and has a looser cluster of pale lilac or white flowers; this is the most popular of the cultivated species of wistaria.

The wistaria was named after Caspar Wistar (1761–1818), a professor in the University of Pennsylvania, and was first spelled "wisteria." It belongs to the *Leguminosae* (bean family).

WITCHCRAFT. There is of course no such thing as witchcraft, and what really concerns us is the belief men used to have in the power of witches. The disappearance of that belief may rightly be called one of the evidences of the real progress of the human race. Witches were said to be women who made a contract with the devil, a contract sealed with blood, to serve him, and in return for that promise were given power by him to accomplish things beyond ordinary human abilities. They could bring sickness and death to whom they wished, they could go through locked doors, they could even ride through the air on broomsticks, and assume animal forms. Their greatest delight was to bring harm and suffering to those who incurred their spite. This they did in many ways, but often they made waxen images of those they sought to harm or kill and then pricked these images or melted them slowly over a fire, so causing wasting away, suffering, and finally death to the persons represented by the images.

According to these strange beliefs, there were great witch assemblies, known as "witch sabbaths," at which the witches met with the devil, performed elaborate and obscene ceremonies, and were instructed by him in the evil they should accomplish. It was believed that the devil left certain marks upon the persons of the witches, secret marks, which could be detected only by those expert in such things.

Most of the women suspected as witches were old ugly mumbling crones, without friends or influence, usually women who had incurred the ill will of neighbors in some way. Often the old crone had uttered foolish words of threat against someone who had made fun of her. The curious thing is that when such women were accused of having bewitched a cow or child or neighbor to death, they would often confess the deed, and add terrible details of guilt.

In all ages and all times there has been a belief among nearly all peoples in magic and evil spirits; the belief is to be found among the Egyptians,

Chaldeans, and notably among the Hebrews. Nevertheless few people actually suffered on charges of witchcraft until the 15th century. Moses had commanded the children of Israel that they should not suffer a witch to live, but King Saul had consulted the Witch of Endor. The growth of a fixed theology, the effort to determine the provinces of the kingdom of the devil and to ascertain his position in the universe, led to a whole system of belief about witches. Certain elements of that system were brought into Christianity from Byzantine lore—as the "witches sabbath" and flying by night. By the 16th century the popes were urging the criminal prosecution of witches. But Catholics were no more to blame than the Protestants for such persecutions, if as much. Protestantism, with its emphasis on the authority of the Bible and its literal interpretation of the Scriptures, intensified the zeal against witches. All sects united in hunting down the agents of the evil one, but Calvinists were perhaps the most unrelenting leaders in that terrible search.

By the 17th century the people of Europe had been taught to look for witches and the courts put to death thousands in Germany and France, and a few hundred in England. In 1692 there was an outburst of witch persecution in Salem Village (now Danvers), Mass., which lasted eight months and in which 19 persons were hanged and one "pressed" to death. By the latter half of the 17th century the more intelligent people were beginning to suspect that witchcraft was a delusion. The new scientific movement and the growth of rationalism affected many people. Judges began to let witches go free. For another century the public made the way of the suspect woman a hard one, and she was often ducked in a pond, but the law was in her favor. John Wesley toward the close of the 18th century declared that to disbelieve in witchcraft was to disbelieve in the Bible. But his was the last voice of that kind. Today, however, in remote districts of both Europe and America, there are people who blame the diseases or losses of their cattle upon some neighbor woman whom they call a witch. But in general the world has ceased to believe in witches or to punish silly old women for imaginary crimes.

WITCH-HAZEL. A true witch of the woods, this shrubby little tree turns the year upside down by bursting into an abundance of bloom when other trees are shedding their foliage and when its own leaves are yellow and falling. Throughout the month of November the tiny yellow clustered blossoms wave on branches already laden with the seed-pods of last year's flowers. When the seeds are ripe these pods have a peculiar fashion of popping open with a sharp click and shooting the seeds to a distance of several feet.

The witch-hazel is found as a shrub in deep ravines, on shaded hillsides, and at the edge of woodlands from New England southward to Florida, and westward to eastern Minnesota. Only on the mountains of North and South Carolina and Tennessee does it attain the height of a tree. Its name probably comes from the fact that the forked twigs were supposed to have magic power in pointing out hidden springs. From the bark and leaves of the witch-hazel is distilled a liquid used in treating bruises and muscular soreness.

Scientific name, *Hamamelis virginiana.* Bark light brown, smooth. Wood light reddish brown, sapwood nearly white; heavy, hard, close grained. Leaves 4 to 6 inches long, alternate, simple, oval with notched edge; dark green above, paler underneath, in fall turning to yellow with rusty spots.

WOLF. Stories of encounters with wolves have been popular for hundreds of years, and it is a real disappointment to learn that few of them are true. Wolves are still very plentiful throughout the thinly settled parts of the United States, and they destroy thousands of sheep, cattle, horses, deer, and other animals every year. Only rarely, however, have they been known to attack man.

The wolf is a carnivorous, or flesh-eating, mammal and formerly was found in all parts of North America, Europe, and Asia. They became scarce in the British Isles in the 16th century and were all killed off by the middle of the 18th century. There are no wolves in South America, Africa, or Australia. Wolves are said to be numerous in the steppes of eastern Russia, and these animals have always been described as being particularly ferocious, and when pressed by extreme hunger have been known to attack human beings.

The American wolves comprise two very distinct species. The larger is commonly called the gray wolf, or timber wolf; the smaller is the prairie wolf, or coyote. The prevailing color of both species is gray, tinged with yellow, but there are black timber wolves in Florida, and white ones in the far north. A large timber wolf stands 27 inches high at the shoulders, and is 66 inches long, including the tail which is 16 inches in length. The coyote is 20 inches high and 48 inches long; its tail measures 15 inches. In wooded regions east of the Great Plains, the coyote is often called the brush wolf.

Timber wolves hunt in pairs or in family groups, while coyotes often hunt in larger packs. Although all wolves are destructive to bigger game, their regular diet consists mainly of rabbits, grouse, and the smaller rodents.

All wolves have powerful jaws, armed with 42 teeth. When angry or excited a wolf presents a truly terrifying appearance. The eyes flash like balls of fire; the lips are drawn back, disclosing the long, white, cruel-looking teeth; and the muscles become tense as if preparing for a spring. When cornered so it cannot escape it fights savagely and is a dangerous antagonist for a man without firearms. But its natural habits are cowardly and contemptible. There is nothing admirable about a wolf aside from its cunning, which is often surprising. Its ability to avoid traps, detect poison, and keep out of range of the hunter's rifle is remarkable.

Wolves are very prolific; their young, which are born in April or May, number from 5 to 13 in a litter. The young are blind at birth and are covered with

soft brown fur. The breeding dens consist of shallow caves or hollow tree-trunks. The female does not permit the male to approach the den, for it happens not infrequently that the male kills and eats his own offspring. He has even been known to kill and eat his own mate. Wolves desert their young when in danger, and kill and devour their wounded and disabled companions.

Owing to the fact that wolves prey upon domestic animals and do immense damage to the Western stock-growing industry, bounties are offered in some states for their destruction. But the most valuable agency in the battle against the wolf is the federal Biological Survey, which has, in co-operation with the states, greatly reduced the loss of sheep and cattle.

Scientific name of timber wolf, *Canis occidentalis;* coyote, *Canis latrans:* European wolf, *Canis lupus.*

THE PIRATE OF THE PRAIRIES

Hungry and gaunt, the Coyote voices the loneliness of the plains with his melancholy serenade. This wary hunter stalks his prey in barnyard or prairie, and he is so fleet of foot that he easily runs down deer or rabbits in a chase. In late summer Coyotes, or Prairie Wolves, hunt in packs composed of their own family groups; more frequently they are seen in pairs.

WOLFE, JAMES (1727–1759). Slender, frail, and studious, James Wolfe, the conqueror of Quebec, was little like the usual ideal of a military hero. But his bright and piercing eye showed that the fire of energy and determination burned bright within; and when in 1759 William Pitt, prime minister of England, needed a commander to administer the finishing blow to the French power in America, he passed over the titled veterans who coveted the honor and entrusted Great Britain's destinies to this young and almost unknown soldier.

But Wolfe, though little known and not highly connected, had been long and thoroughly schooled in war. He had entered the army at 14, following in the footsteps of his distinguished father, Gen. Edward Wolfe. Skill and bravery won steady advancement for him, and at 31 he had been sent to North America with the rank of brigadier-general, to assist in the expedition against Louisburg, one of the strongholds of French power in the New World. His brigade effected a landing under heavy fire and played an important part in the memorable siege which resulted in the capture of that fortress (1758). Because of his skill and boldness, Wolfe was called the "hero of Louisburg"; and a few months later when Pitt resolved on the capture of Quebec, he gave young Wolfe the command of the expedition with the rank of major-general.

The taking of Quebec by Wolfe has been styled "one of the epics of modern military history." For three months he tried in vain to take the almost impregnable position of the French, who were entrenched below the town. At last, depressed by his many failures and enfeebled by internal disease, Wolfe embarked on the bold exploit which made his name forever glorious. He crossed the river above the town, in the early morning hours of September 13, surprised the French sentinels at the cove which now bears his name, climbed the steep heights, and by daybreak had 4,000 men drawn up in battle array on the Plains of Abraham. As he led his men in the battle that followed, General Wolfe was wounded three times, and died before the pursuit was ended (*see* French and Indian War; Quebec).

WOLSEY (*wọl'sĭ*), CARDINAL THOMAS (1475?–1530). "The proudest prelate that ever breathed," as Cardinal Wolsey has been called, shaped England's policy abroad and was the leading figure in church and state at home for more than a decade during the early years of Henry VIII. His foes contemptuously referred to him as "a butcher's son," for he was the son of a wealthy citizen of Ipswich who sold meat as well as

other commodities. Young Thomas was sent to the University of Oxford, where he took his degree at the age of 15. After becoming a priest, he was appointed chaplain to Henry VIII. His extraordinary powers won for him rapid advancement, and soon he was Henry's principal minister. He was made chancellor of the kingdom and archbishop of York, and Henry secured from the pope his appointment as cardinal, and the pope's legate or representative in England.

Soon all authority was concentrated in the hands of the great cardinal. He made peace and war. England was too narrow a field for his vast ambition; he aspired to be the arbiter of Europe. He threw England's influence into the scale on the side of the Emperor Charles V in the latter's rivalry with Francis I of France, expecting thereby to enlist the emperor's aid for his own aspirations to the papacy.

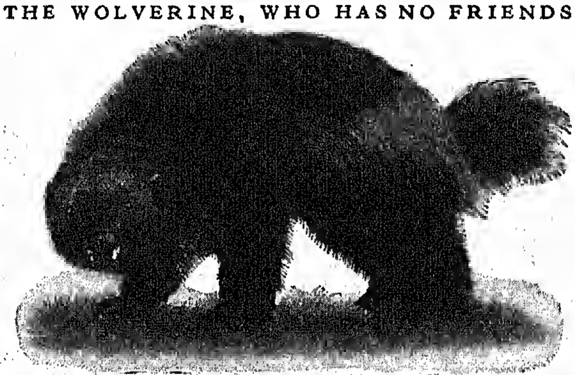
The costly splendor of his palaces, his gold and silver plate, and his New Year's gifts outshone those of kings. His servants knelt to wait on him; bishops tied his shoe-latchets; dukes held the basin while he washed his hands. Ambassadors might consider themselves honored in being permitted to kiss his hand, but might not, on pain of the cardinal's displeasure, presume to discuss new business with the king before broaching it to Wolsey.

Prodigiously able, indefatigably industrious, he ruled with a firm hand, doing swift unsparing justice, ruthlessly sweeping away feudal jurisdictions, and initiating that policy of dissolution of monasteries which was to be carried through to completion by his royal master King Henry VIII. Some of the confiscated religious property he applied to the foundation of Christ Church College at Oxford University. But his greed, his arrogance, and his insatiable lust for power outweighed his many great qualities, and the sumptuous edifice of his grandeur was built on sand. His more than regal state was sustained, not by the revenues of his many offices alone, but also by what today would be considered corruption—enormous pensions from foreign sovereigns, bribes from English suitors for justice, and the misappropriated revenues of the suppressed religious foundations. His policies and his haughtiness alienated churchmen and laymen alike. Charles V had judged it prudent to see that the intractable Wolsey should not become pope. His power had no more stable base than the favor—which for 20 years, to be sure, had seemed as solid as the hills—of the careless, pleasure-loving king.

But Henry VIII was developing a taste for the substance of that power so long monopolized by the mighty chancellor. The costliness of Wolsey's showy foreign policy was added to other grounds for popular murmurings against him. When, having made himself responsible for the success of Henry's appeal to Rome for a divorce from Catherine of Aragon, the cardinal committed the unpardonable crime of failure, his doom was sealed. The king's rage, overflowing all bounds, in a moment swept away every one of Wolsey's civil offices and preferments. His retirement to his archbishopric of York—which he had never before visited—did not place him beyond the reach of the king's unsated anger. Summoned to London to answer to a charge of treason, he died on the way, crying out—so says tradition—"Had I but served my God as faithfully as I have served my king, He would not have given me over in my gray hairs."

Wolverine. A notorious glutton and pest and a remarkably cunning thief, the wolverine has no friends. The trapper especially hates it, for again and again it steals his bait and his capture, and sometimes even carries off trap and all. It will raid cabin and camp, destroying in wholesale fashion, seemingly from pure malice. Because of its strength and cunning, both Indians and Eskimos look upon this animal with a sort of awe and make offerings to propitiate its evil spirit. The Eskimos wear a bit of wolverine fur in order that they may acquire some of its power.

THE WOLVERINE, WHO HAS NO FRIENDS



The Wolverine is the largest of the American fur-bearing animals of the family *Mustelidae*, to which the weasels, otters, badgers, and skunks belong. It is a notorious glutton and a remarkably cunning thief.

The wolverine is a member of the weasel (*Mustelidae*) family. It inhabits the northern forests of Europe, Asia, and America. The American wolverine is about the size of a bulldog, and has a body and paws similar to those of a bear. It is probably the most powerful animal for its size in existence. The body is covered with shaggy hair of a blackish color, with pale bands along the sides and one on the forehead. It feeds on squirrels, hares, foxes, grouse, and other animals. The glutton, as the Old World species is called, is similar in appearance and habits.

Michigan is called the Wolverine State because in early days the wolverine abounded in its forests. The animal is found in the northern Cascades, and in the Rockies as far south as Great Salt Lake, although it is becoming quite rare. It occurs in greater numbers in arctic America, abounding in portions of Alaska. Despite its bearlike structure, the wolverine is unable to climb trees. It dwells in underground dens. Scientific name, *Gulo luscus*.

WOMAN'S CHRISTIAN TEMPERANCE UNION. This society, one of the world's largest organizations composed exclusively of women, has waged unremitting battle against the liquor traffic for half a century. It grew out of the Women's Crusade, started in 1873 by the women of Hillsboro and Washington Court House, Ohio, to fight the saloons. Then came the Woman's Christian Temperance Union, organized in Cleveland, Ohio, in 1874, at a meeting to which women came from 16 states. In 1883 the "W.C.T.U." as it is popularly known, was incorporated. It now has more than 10,000 local branches in American cities and towns, with about half a million members. All members must sign the total abstinence pledge and pay annual dues. The white ribbon is the Union badge.

The W.C.T.U. has a Young People's Branch and a Loyal Temperance Legion for the younger members and a number of separate state groups among the colored race. The program of work, besides temperance, includes Americanization, work for women in industry, child welfare, and other betterment efforts, under the direction of some thirty departments. Temperance education in the schools is directly the result of efforts by this organization.

The headquarters of the national W.C.T.U. are at Evanston, Ill., under the same roof with the former home of Frances E. Willard. In addition it owns in that city a large brick building that houses the editorial rooms, publicity bureau, and business offices of the Union. Besides its campaign and department literature the W.C.T.U. publishes its weekly official organ, *The Union Signal*, and also *The Young Crusader*, a monthly paper for children.

The World's Woman's Christian Temperance Union was founded in 1883 by Frances E. Willard. To this international organization the women's temperance societies of over fifty other nations belong, adding about another half-million to the half-million American members of the Union.

WOMEN'S CLUBS. In the World War, as in every important movement for good in the past 50 years of United States history, a very influential part was played by the clubs and other organizations of active and patriotic women. In the United States women's clubs date from 1868, when two clubs started at practically the same time—the Sorosis in New York, with Jane C. Croly ("Jennie June") as president; the other, the New England Woman's Club, under the leadership of Julia Ward Howe.

We can roughly divide women's clubs into the two groups of those that have the social or cultural aims of members as their object, and those working for civic betterment and the making of better laws, especially for women and children. Naturally many clubs combine social, cultural, and philanthropic aims. In all there are about ten thousand women's clubs in the United States. In 1889, when women's clubs had spread all over the Union, Sorosis called a convention with the idea of organizing a general federation and 21 clubs sent delegates. The next year a general federation was formed. Two years later Maine organized a state federation, and since then every state, including Alaska and the District of Columbia, has like groups. The General Federation of Women's Clubs meets every second year and its membership includes individual clubs as well as state and local federations. Affiliated with the General Federation are other groups, such as the National Kindergarten Association, the International Sunshine Society, and similar organizations of other lands. The work of the General Federation is carried on through departments, patterned much on the same plan as that of any large woman's club.

Too much cannot be said for the work accomplished by these clubs. Besides their great cultural value to their own members, they have founded and maintained thousands of public and traveling libraries, kindergartens, scholarship funds for ambitious students, and traveling exhibits of art and of household art and appliances; they have equipped and opened many playgrounds and parks, and have done valuable civic work along many other lines. In many instances the women have financed promising experiments in education or civic work until the experiments had opportunity to prove themselves worthy of public support, which they could not have done without this private help. But the greatest service the women's clubs have rendered is, perhaps, the education of public opinion along the lines of child welfare, improved legislation, social hygiene, public health, and other agencies of higher and better civilization.

WOMEN'S RIGHTS. Woman's progress has been a gradual one, becoming more marked as both men and women learned that one could not advance far without the other. Most uncivilized races hold women inferior to men, but as civilization progresses it is recognized that all the people, men and women alike, must be fitted to bear a share in the nation's support and betterment.

Under certain systems of ancient law, traces of which have survived into modern times, a woman, no matter how old, was theoretically a perpetual minor—always subject to control by father, husband, or some male guardian. Her actual status often was much better than her theoretical legal position; but the legal inferiority was a practical handicap and represented, moreover, a general conviction that sex differences must be reinforced by artificial distinctions in privileges and rights. So old-fashioned propriety has usually shaken its head in shocked protest when women demanded new privileges—higher or professional education, the privilege of earning their own living outside the home, of competing in factories, business, or the professions on an equal basis with men, the right to control their own property, and, most important of all, a voice in making the laws which control their own well-being and that of their homes and children.

In the early history of the women's rights movement, the struggle was for educational opportunities and the right to enter business and the professions. Then feminists turned to the fight for suffrage. This achieved, they have attacked other inequalities, using the ballot in their work for an improved legal status and for advanced social legislation.

Margaret Brent, heir and executrix of Gov. Leonard Calvert of Maryland (brother of Lord Baltimore), is believed to have been the first tax-paying woman in America to ask political representation. She demanded "place and voice" in the Maryland legislature in 1647, and her plea was refused only after hot debate. Tax-paying widows and "spinsters" (unmarried women) voted later in some of the colonies—New Jersey, for instance; and women sometimes attended New England town meetings, either on their own account or as representing their husbands.

In France, Olympe de Gouges in 1789 published a 'Declaration of the Rights of Woman' as a protest against the omission of any mention of women from the Revolutionists' 'Declaration of the Rights of Man'. A petition for woman suffrage presented to the French National Assembly in the same year was refused. The Code Napoleon or code of laws promulgated under Napoleon deprived French women of many rights they had formerly enjoyed.

An Englishwoman, Mary Wollstonecraft, inspired by the French Revolution and Olympe de Gouges' protest, in 1792 published 'A Vindication of the Rights of Women', which has remained a landmark in the women's rights movement. Seventy-seven years later the English political philosopher John Stuart Mill (1806–73) published an even more notable contribution in his essay entitled 'On the Subjection of Women'.

Beginnings in the United States

The organized women's rights movement began in the United States in 1848, as a direct outgrowth of the anti-slavery struggle. In 1840 several women delegates, among whom was the Quakeress Lucretia Mott (1793–1880), were sent to a World's Anti-Slavery Convention in London, but were not allowed to take their seats. Lucretia Mott and Elizabeth Cady Stanton (1815–1902) thereupon resolved to hold a women's rights convention on their return to America; and eight years later it was held at Seneca Falls, N.Y. Although the movement received aid from broad-minded men like William Lloyd Garrison, Wendell Phillips, Henry Ward Beecher, and Ralph Waldo Emerson, the women pioneers, prominent among whom were Susan B. Anthony (*see* Anthony, Susan B.), Lucy Stone (1818–1893), and Julia Ward Howe (1819–1910), faced ridicule for many years.

In 1869 women from 19 states met in New York and formed a National Woman Suffrage Association, headed by Elizabeth Cady Stanton and Susan B. Anthony, to work for an amendment to the Federal Constitution enfranchising women. Later in the same year was formed the American Woman Suffrage Association, headed by Henry Ward Beecher and Lucy Stone, working to obtain suffrage chiefly through amendments to the state constitutions. The two bodies united in 1890 to form a National American Woman Suffrage Association, which thereafter pursued both methods.

For 50 years representatives of the National Association had hearings before the committees of every Congress, but the campaign in the states was the first to show results. The first territorial legislature of Wyoming, in 1869, gave women the vote; the territory of Utah did the same thing next year; and both states came into the Union (in 1890 and 1896, respectively) with woman suffrage clauses in their constitutions. Colorado had granted women suffrage in 1893; Idaho in 1896. One by one other states fell in line, until by the end of 1919 the women of 15 states had equal suffrage with men, and in 12 others the right to vote for presidential electors.

Constitutional Amendment

A woman suffrage amendment to the Federal Constitution had been presented to every Congress since 1878. Previous to 1914 it had never been discussed in the House, only once in the Senate, and usually it had not been reported out of committee. By 1917 its ultimate passage was recognized as inevitable. In 1918 and again in 1919 it passed the House and just failed of passage in the Senate. In May 1919 it was passed at a special session of the newly elected Congress. Illinois was the first state to ratify the amendment. Ratifications were obtained from the necessary three-fourths of the states, and as the Nineteenth Amendment to the Federal Constitution it was proclaimed Aug. 26, 1920, so that women citizens throughout the United States were enabled to vote at the presidential elections in November of that year. The amendment, as now enacted, reads:

> The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of sex.
>
> Congress shall have power to enforce this article by appropriate legislation.

Meanwhile new leaders had been growing up in the movement to take the place of those dropped out because of advancing years. Mrs. Stanton had resigned the presidency of the National Association in 1892, at the age of 77; Miss Anthony, her successor, had resigned in 1900 at the age of 80, to be succeeded by Mrs. Carrie Chapman Catt, who was president continuously thenceforward except for the eleven years between 1904–15, when Dr. Anna Howard Shaw (1847–1919) was president. Mrs. Rachel Foster Avery, corresponding secretary for 21 years, Mrs. Harriet Taylor Upton, national treasurer for 15 years, and Miss Alice Stone Blackwell, recording secretary for 20 years, were among the other women whose many years of devoted effort contributed to the final victory of the woman suffrage amendment. In 1920 its object attained, the National Association passed out of existence, its place being taken by the National League of Women Voters.

In 1913 a feeling of dissatisfaction with the conservative methods of the National Association had resulted in the formation of the Congressional Union, led by Miss Alice Paul, which copied the methods of the British militant suffragettes, picketing the White House, publicly burning President Wilson's speeches, and "heckling" speakers. In 1917 this movement became the National Woman's Party.

In Great Britain a similar division of sentiment had existed between the National Union of Women's Suffrage Societies, which followed conservative methods and the National Women's Social and Political Union, the organ of the "militant suffragettes," headed by Mrs. Emmeline Pankhurst and her daughters Christabel and Sylvia Pankhurst. Believing that "political rights are never granted save in response to irresistible pressure," these women adopted the policy of doing whatever in their belief would either embarrass the government or call attention to their cause. When the World War broke out in 1914 the militants declared a truce and the suffrage leaders of both parties generally devoted themselves to the service of the government. By that time many of the most powerful opponents of woman suffrage, including the prime minister Mr. Asquith, had come to regard it as inevitable, and its grant was now urged as a fitting recompense for women's war services. A bill conferring the suffrage on women over 30 was passed in 1918, adding 6,000,000 voters to the electorate. Ten years later the age limit was lowered to 21. This added 5,000,000 more women voters, who then outnumbered the male voters.

Gains in the British Colonies

Several British colonies and many European countries had previously given women full or partial suffrage. New Zealand was the first country in the world to grant women complete suffrage (1893). The Commonwealth of Australia gave national suffrage in 1902; the several Australian colonies conferred state suffrage on their respective women citizens, some before and some after the grant of the Commonwealth suffrage. The Dominion of Canada gave national suffrage in 1918; all the Canadian provinces except Quebec and Prince Edward Island had by that time granted full suffrage—Manitoba, Alberta, Saskatchewan, and British Columbia in 1916, Ontario in 1917, and Nova Scotia and New Brunswick in 1918; the Territory of the Yukon followed in 1919.

The modern movement toward equal political privileges began on the continent of Europe with Sweden's grant in 1862 to women taxpayers (widows and spinsters) of a vote for all officials except members of parliament. The first European country to give women full suffrage was Finland (1906). Norway followed with a limited franchise in 1907 and full suffrage in 1913. The World War aided the movement by its social and political upheavals, and by adding to women's responsibilities. Among countries that have given women full suffrage are Iceland (1914), Denmark (1915), Russia (1917), Sweden, the Netherlands, Rumania, Esthonia, Eire (Ireland), Turkey, Luxemburg, the Union of South Africa. In Latin America full suffrage rights are enjoyed by the women of Cuba, Jamaica, Uruguay, and Ecuador. In Asia, the veil and the harem are disappearing. British India and many of the native Indian states grant full suffrage, as do China, Ceylon, Burma, Siam (Thailand), and the Philippine Commonwealth. Many other countries have partial suffrage for women, as in Belgium. In France, Switzerland, Germany, Italy, and Japan, women have little share in public life.

The International Woman Suffrage Alliance was formed in 1904. In the same year the International Council of Women made the promotion of woman suffrage a part of its work. These two great organizations have steadily lent aid in various countries to the efforts made by women as yet unenfranchised.

The right to hold office has sometimes followed and sometimes preceded the grant of the suffrage. In various American states women have long been eligible to certain offices, particularly those connected with education; and in a few states the office of state superintendent of education has been customarily filled by a woman. One of the most notable educators who have filled the office of city superintendent of schools in the United States was Mrs. Ella Flagg Young, superintendent of Chicago schools 1909–15. The first woman elected to the United States Congress, Miss Jeannette Rankin, took her seat as representative at large of the suffrage state of Montana in 1917, three years before suffrage was extended to all women citizens of the United States. Women senators and representatives have been elected to various state legislatures, and also to some of the Canadian provincial legislatures. Women are now eligible to all civil offices in the United States. The first woman to take a seat in the British Parliament (1919) was Lady Astor, the American-born wife of Viscount Astor. Women delegates have played a significant part in the conventions of all political parties in the United States since 1920. Women have held various city offices, from mayor down, in the United States and in Great Britain. Mrs. Nellie T. Ross, in Wyoming, and Mrs. Miriam A. Ferguson, in Texas, were the first women elected governors in the United States. Mrs. Rebecca L. Felton of Georgia sat in the Senate for two days in 1922 by appointment. The first woman elected to the Senate was Mrs. Hattie Caraway of Arkansas, chosen in 1932.

In 1933 Frances Perkins, appointed secretary of labor by President Roosevelt, became the first woman cabinet member; Mrs. Nellie T. Ross became the first woman director of the mint; and Mrs. Ruth Bryan Owen was made minister to Denmark. In 1937 Mrs. Florence Jaffray Harriman was appointed minister to Norway.

WOODCOCK. The woodcock is also known as the "gig-headed snipe," for it belongs to the snipe family. It is about 11 inches long, and is feathered in variegated brown, gray, and black. Its most noticeable feature is its very long bill, with which it extracts

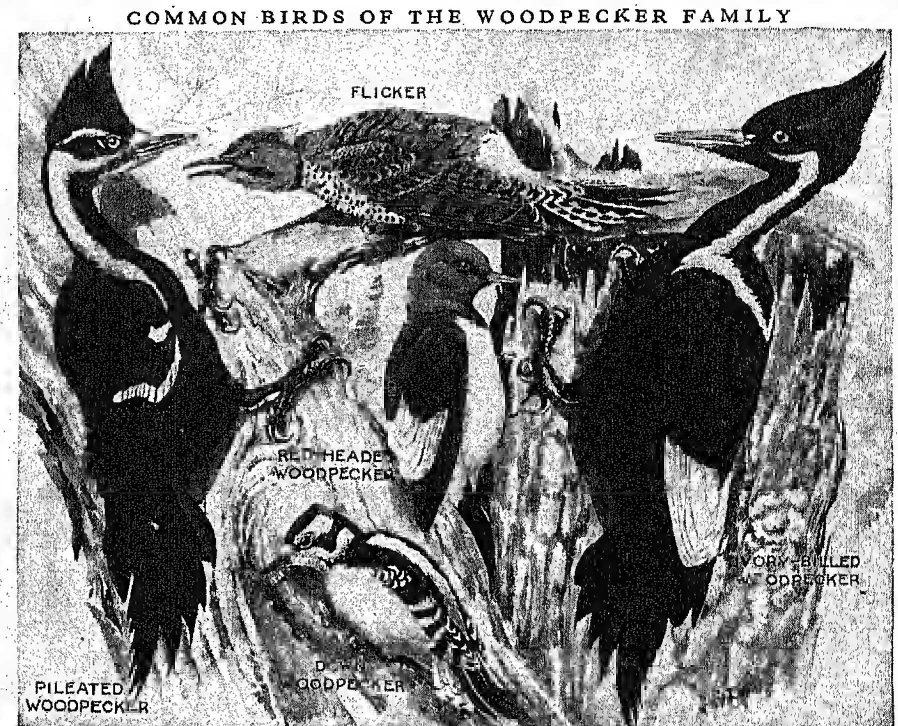
worms from the soft ground of the swamp. The woodcock usually spends the day in some shadowy retreat, flying to a favorite resort for its evening meal. It is an excellent game bird.

During the mating season, the male gives a regular twilight exhibition. Soon after sunset he may be seen above the marsh, whirling in spirals to a height of 50 or 60 feet, then he circles horizontally and, as he descends, utters his cheeping cry. Upon reaching the ground, with dragging wings he struts like a tiny turkey-gobbler. Sometimes he repeats this performance for more than an hour at a time.

Woodcocks nest on the swampy ground, the nest containing three or four olive-gray eggs streaked with brown and black. They breed from the northern half of the United States to Alaska and winter in the southern states and through Central America and Brazil. The European woodcock is slightly larger than the American species. Scientific name, *Philohela minor*.

WOODPECKER. The woodpecker is a knocker! But he indulges in this practice to good purpose. He goes up and down the side of a tree with a *rap, rap* of his stout beak against the bark, and when his keen ears detect the sound of an insect within, he drills rapidly with his chisel-pointed hammer, until his long tongue can reach and bring forth the victim. The larvae of moths and beetles make up a large part of the woodpecker's food. When a pair of woodpeckers want a home, their picklike bills and strong neck muscles enable them to make a deep hole in some decaying tree or post, and on the chips that fall to the bottom of this hole Mrs. Woodpecker lays her glossy white eggs and rears the young.

COMMON BIRDS OF THE WOODPECKER FAMILY



Probably the best known of these is the Red-Headed Woodpecker, whose red head and black-and-white body are familiar in most parts of North America. The little Downy Woodpecker gets his name from the fluffy feathers of his body, and the Flicker from the curious cry he emits. The Flicker's back is olive-brown barred with black, and the rump and upper tail feathers are pure white; the wings and tail on the under-side are yellow, from which it is sometimes called the Yellowhammer or the Golden-Winged. The Ivory-Billed Woodpecker and the Pileated Woodpecker are the largest and scarcest members of the family.

Members of the woodpecker family (*Picidae*) are characterized by short stout legs and toes, sharp claws, and stiff tail feathers, terminating in sharp spines which can be pressed against the bark to help support the bird in an upright position while it works. The most peculiar point in the anatomy of these birds is the tongue. This is cylindrical and at the front end terminates in a hard point, with barbs upon the sides. It can be thrown out to great length and it is a most effective instrument for dislodging ants and grubs from their bark burrows.

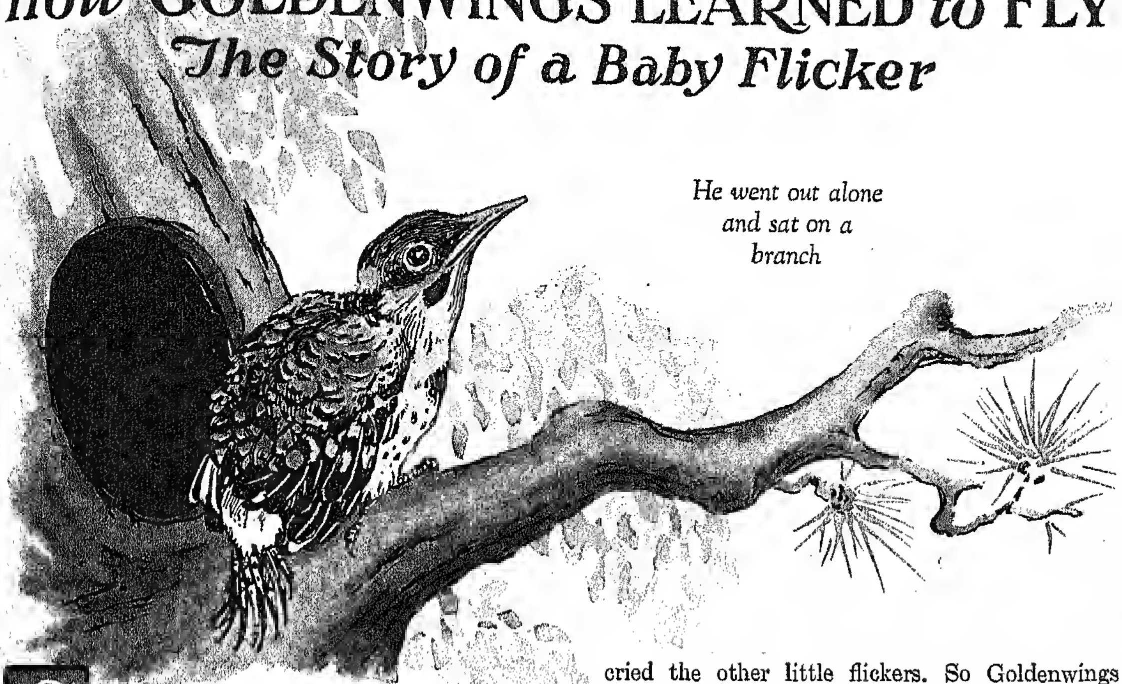
Woodpeckers are found in all wooded portions of the world except on the island of Madagascar and in the Australian region. As a family they are less migratory than most other birds and the majority of the species occupy the same range throughout the year. Most of these birds have a wavy galloping flight. Though they do not sing, they have distinctive and in some cases musical calls. The drumming sound, which is their common mating call, is made by the extremely rapid hammering of the bill on a hollow tree or, in towns, often on house roofs or water-spouts.

Woodpeckers usually have a plumage of barred or spotted black and white, or brown and black, marked about the head with red or yellow. In size they range from the ivory-billed woodpecker, 21 inches long, to the downy woodpecker, $6\frac{1}{2}$ inches long. They are mostly tree-dwelling birds, only the flicker feeding on insects, especially ants, found on the ground. (For illustration in color of the downy woodpecker and the flicker, *see* Birds.)

The woodpeckers are a much maligned family, for they rarely disfigure a healthy tree and every year they destroy countless millions of harmful insects.

How GOLDENWINGS LEARNED to FLY

The Story of a Baby Flicker



He went out alone and sat on a branch

GOLDENWINGS, a little flicker, waked one morning in early spring and opened his mouth as wide as he could. "I'm hungry! I'm hungry!" he called. He made so much noise that his five little brothers and sisters opened their eyes. Then they all began to call for food as loud as they could.

The nest in which the six little flickers lived was in a hole in a tree near the edge of a wood. The mother and father flicker had made this nest with their sharp round bills. They had pecked out a small round hole for the doorway, and then made a larger room inside. It had taken them more than a week to hollow out the nest, because they had been careful to carry all the chips away. They didn't want a pile of chips at the foot of the tree, telling everybody where their nest was.

Now mother flicker put her head in at the doorway and looked at the six hungry littlo flickers.

"Oh! So you are awake and hungry again as usual," she said. "It seems to me your voices grow stronger each morning. Well, snuggle down a minute, and father and I will bring your breakfast very soon."

She flew away as she spoke and the six little flickers settled down once more and closed their eyes.

"Let's all go out and sit on a branch of the tree, the way we did yesterday," Goldenwings said after a while. "It is so nice out there."

"We don't want to! We want our breakfast!" cried the other little flickers. So Goldenwings went out alone and sat on a branch in the sunshine.

He liked to sit out here and watch the other birds flying past him. For a little while he sat very still. After a bit, because he was getting hungrier every minute, he began to call as loud as he could: "Mother! Father! Come and feed me! Come quick! Come quick! Come quick!"

"What is all this noise?" said a voice. A screech owl poked his head out of a hole farther up the tree. "How do you suppose I can sleep?"

Goldenwings looked up. There, right above his head, he saw two eyes staring down at him. They were very large eyes. They frightened Goldenwings because they looked so fierce. Just then mother and father flicker flew back. Goldenwings forgot all about the screech owl, as he stretched his bill wide open. His father stuffed a fat caterpillar down his throat.

Mother flicker flew inside the tree to feed the other little birds. When they saw her each little flicker cried louder than ever. Once again the screech owl poked his head out of his door.

"Can't you woodpeckers keep your children quiet?" he scolded. "They make so much noise that I can't get a wink of sleep."

"You should sleep at night the way we do," father flicker said. "Then these children wouldn't bother you."

"*Night* isn't the time for owls to sleep!" The screech owl was surprised. "Owls always sleep in the daytime."

"Well," said father flicker, "I'm afraid you won't get much sleep today, screech owl. It's going to be pretty noisy here at my tree."

The screech owl poked his head still farther out of his door. "What do you mean by calling this *your* tree?" he asked, ruffling his feathers. "This is *my* tree! My home is right here in this hole."

"Yes, but we made it for you," mother flicker told him, putting her head out of her own door. "You wouldn't have that hole to live in if father flicker and I hadn't made it."

The screech owl looked down at her and blinked his eyes. "Did you woodpeckers make this hole?" he asked.

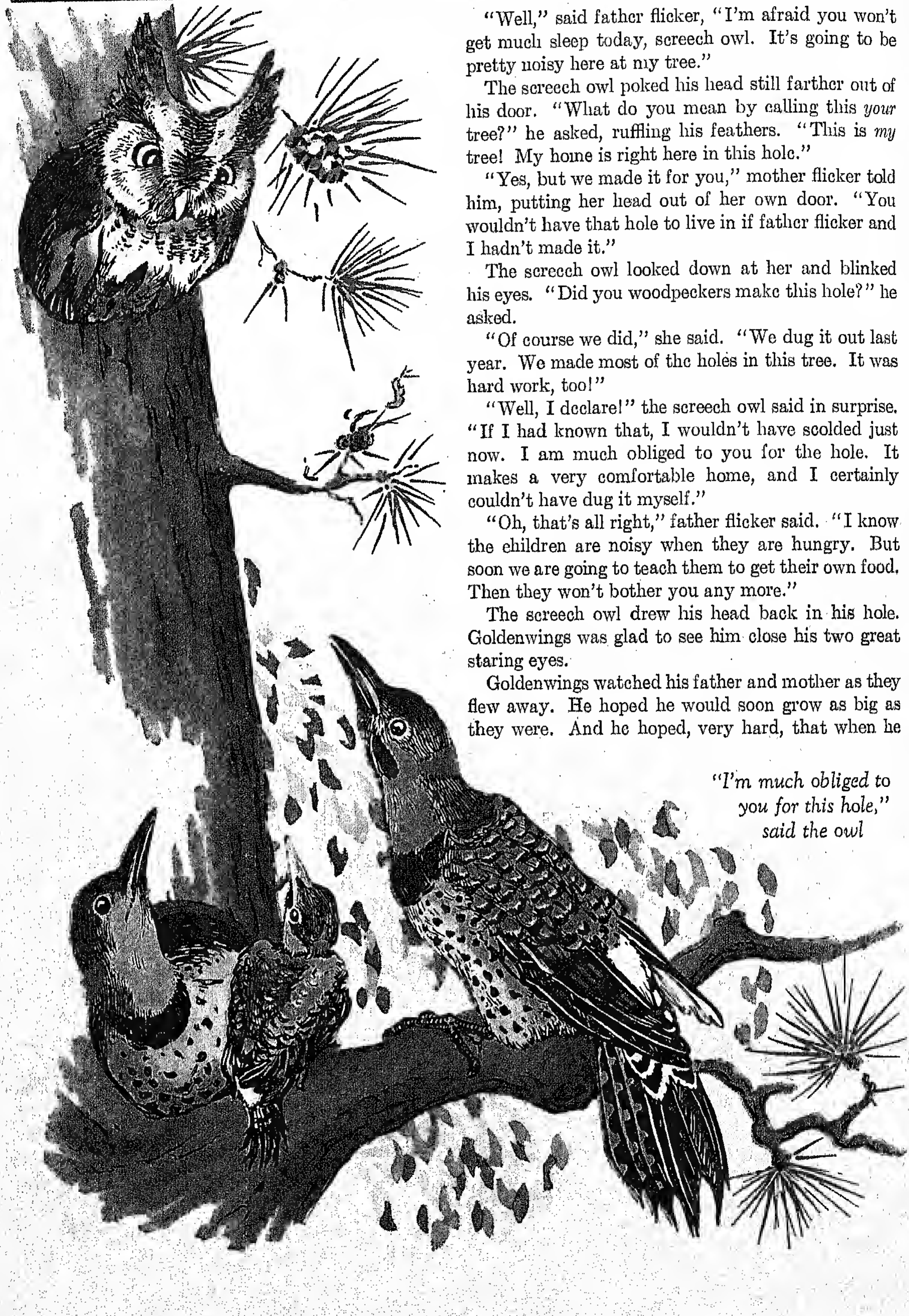
"Of course we did," she said. "We dug it out last year. We made most of the holes in this tree. It was hard work, too!"

"Well, I declare!" the screech owl said in surprise. "If I had known that, I wouldn't have scolded just now. I am much obliged to you for the hole. It makes a very comfortable home, and I certainly couldn't have dug it myself."

"Oh, that's all right," father flicker said. "I know the children are noisy when they are hungry. But soon we are going to teach them to get their own food. Then they won't bother you any more."

The screech owl drew his head back in his hole. Goldenwings was glad to see him close his two great staring eyes.

Goldenwings watched his father and mother as they flew away. He hoped he would soon grow as big as they were. And he hoped, very hard, that when he



"I'm much obliged to you for this hole," said the owl

did grow up, he would look just like them. He wanted to have a bright scarlet band on his head, and bands of black across his back.

Most of all, he wanted to have a bright yellow color under his wings, as his mother and father had. It looked so pretty when they flew in the sunshine. "I think I will have it, too," he said to himself. "Mother says my wings are already getting yellow—that's why she calls me Goldenwings."

Father and mother flicker were now out of sight, and Goldenwings was beginning to grow a little tired of sitting still. He looked around for something to do. Just then his sharp eyes spied a number of tiny insects running over the bark of the tree. Quick as a wink his long, round tongue darted out and caught one of them on its sticky tip.

"Why," he said in surprise, "it's food! Who would have thought that I'd find food right here in my tree!"

He was so pleased with himself that he caught another and another and another. Presently he dug his sharp little claws into the bark and began to creep slowly around the tree, eating insects as he went.

"This is just the way father and mother do," he thought. He was very proud of himself. "I wonder if I could fly like them, too?" He sat on a branch to think about this for a while. Just to see how it would feel to fly, he began to move his little wings up and down . . . up and down. .

At first he moved them slowly. By and by he made them go faster and faster, and then, all at once, his little claws let go the branch . . . and down Goldenwings fell!

Down—down—down! He flapped his little wings as hard as he could. "I'm flying!" he said, "I'm flying, just like my father and mother!"

But Goldenwings wasn't really flying as well as he thought he was. He landed on the ground with a thump, right beside a fat robin, who was looking for a worm in the grass.

"Mercy!" said the robin. "What do you mean by lighting on the ground like that!"

Goldenwings was frightened. He had never been on the ground before, and everything looked so strange down here that he began to call: "Mother! Father! Come and get me! Come and get me!"

"You mustn't make a noise like that when you are on the ground," the robin told him. "If you do, some creature will hear you and come along and eat you up!"

The little flicker stopped calling. "Who will eat me up?" he asked quickly.

"A cat, maybe," said the robin, as it hopped away. "Cats love to eat little birds who are learning to fly."

This scared Goldenwings so badly, that for a while he didn't make a sound—he didn't even move. Presently he saw some tiny creatures running along through the grass. He caught one of them on the end of his long, sticky tongue.

"More food!" he cried, hopping a little in his excitement. "It's good food, too!"

Then he went on catching ants as fast as he could. He was so busy that he didn't even see his mother until she spoke to him. "Well, Goldenwings," she exclaimed, "you are really finding your own food, aren't you?"

"Who will eat me up?" he asked quickly

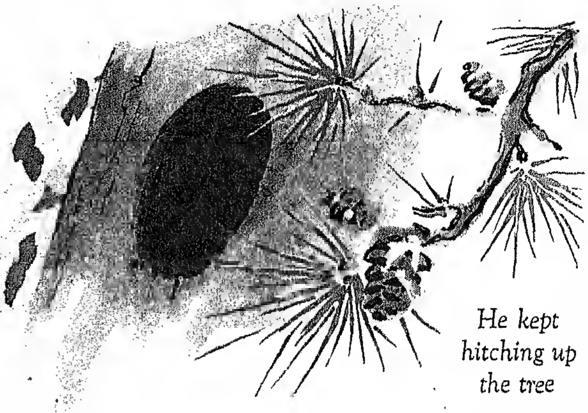
"It's fun!" Goldenwings cried. "I like this sort of food."

"Yes, ants are good," she said, shooting out her long tongue and catching a few herself. "There is nothing we flickers like better, though we are very fond of beetles and caterpillars and grasshoppers and other insects."

"But, mother," interrupted Goldenwings. "Won't I hunt some of my food in trees? When you were gone I caught some funny little things that tasted awfully good."

"Oh, yes," she answered. "Have you noticed what a sharp point your bill has? Soon you will be strong enough to drill holes in trees with it and catch fat little grubs, if you want to. But we flickers prefer to get most of our food on the ground. You will like to eat berries, too."

"What else will I do, mother?" Goldenwings asked, hopping nearer.



He kept hitching up the tree

"Well, some day you will dig the biggest hole of all in a tree," she told him, "and it will be your home. There you and your mate will raise a family of your own."

"Aren't there lots of things to do?" Goldenwings cried. "I hope I can soon do all of them."

"You must learn to fly well, first," his mother said quickly. "I think you had better try it now for a little while."

So Goldenwings fluttered his wings and flew a few feet just above the ground. He was pleased. He tried it again. This time he didn't watch where he was going and he flew right against a tree. At first he was terribly frightened, but he held on to the bark with his claws and called for his mother.

"That's fine, Goldenwings!" she told him, lighting on the tree beside him and propping herself up with her strong tail. "Now watch me and see if you can't climb up the tree the way I do. Come on."

Goldenwings wasn't frightened any more. He flattened his tail feathers against the rough bark and gave a hop, and sure enough, he was a little farther up the tree!

He just loved this. It was more fun than being on the ground. He kept hitching up the tree until, at last, his mother said:

"Here we are! Here we are at home again, Goldenwings!"

And there was the little round doorway to the nest right before them!

Goldenwings had flown down to the ground; he had found food for himself; and now he was safely back home again! He was so excited at the thought of all this that he called loudly to his brothers and sisters: "I know how to fly! I know how to fly!"

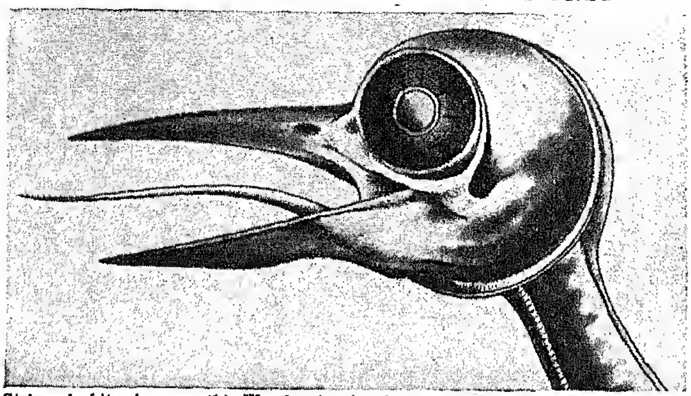
But they were fast asleep and didn't hear him.

Tired out with all the things he had done that morning, Goldenwings hopped into the nest and snuggled down. "Tomorrow," he thought, "I will try to peck a hole in the tree and find a fat little grub to eat."

The only exceptions are the sapsuckers, the best known of which is the yellow-bellied sapsucker of eastern North America. In the spring these birds bore many holes through the bark of sap trees, so they can sweep in the sap with their brushlike tongues. Trees so attacked often die. The red-breasted sapsucker of California also does considerable damage.

The ivory-billed woodpecker is the most magnificent of North American woodpeckers. It is black, with white on the shoulders and wings, and the males have a searlet crest. It is a southern bird, only occasionally found as far north as Illinois. The pileated woodpecker is next in size, sometimes 19 inches in length. Its plumage is rusty black with a showy scarlet crest. It is very wild and rare. The red-headed woodpecker is very abundant through most of the United States east of the Rocky Mountains. Its head is red, back black with white patches, and under parts white. This well-known bird adds grasshoppers and flies to the regulation woodpecker diet. Its rain-call is familiar to all who know the bird but this is only one of its many calls, for it is the noisy member of the group.

HOW THE WOODPECKER SPEARS HIS PREY



Stripped of its plumage, this Woodpecker head reveals an astonishing mechanism. To drive the sharp beak forcibly into the wood there are powerful muscles in the stocky neck and over the well-knit skull. To dart the long, slender tongue rapidly back and forth there are levers of bone that almost encircle the head. Muscular bands propel this forked bone of the tongue. The bill cuts into the tree and exposes the prey; quickly the tongue stabs the victim with its javelin point, whose jagged edge no grub or larva can escape.

Scientific name of ivory-billed woodpecker, *Campephilus principalis;* of pileated woodpecker, *Phloeotomus pileatus;* of red-headed woodpecker, *Melanerpes erythrocephalus;* of downy woodpecker, *Dryobates pubescens;* of northern flicker, *Colaptes auratus luteus.*

WOOD-WIND INSTRUMENTS. The most primitive of wood-wind instruments is the fife or flute, from which developed in early Greek times the Pipes of Pan, or syrinx, a bundle of hollow reeds fastened together so that the performer could play a melody by blowing across the top of first one, then another. Flutes made of the hollow leg-bones of birds have been found among the relics of the ancient cave dwellers. The breath of the player, blown across a hole drilled into the side of the bone, caused the air in the hollow tube of the bone to vibrate and produce a tone, just as in the flute of today.

Most modern flutes are made of carefully finished wood. Some are made of silver, and others have even been made of carved ivory, but the tone of the wooden instrument is preferable. The flute is furnished with a set of keys which make it possible to produce all the tones of any scale. It has a voice so acute that a melody played on a flute can be heard above all the other instruments of a full orchestra. The smallest type of flute, the piccolo, sounds the shrillest notes of the orchestra. The fife, which resembles the flute except that it has six finger-holes instead of keys, is used chiefly in military music.

Other instruments in the wood-wind group are the oboe, English horn, clarinet, and bassoon. These differ from the flute in that they all have single or double reeds fitted into the mouthpiece. The oboe is larger than the flute and has a double reed in its mouthpiece. Unlike the flute, it is played from the end and is slightly conical in shape. Its tone is somewhat like that of the violin, but shriller and more penetrating. It is often used for plaintive and rustic effects. The English horn is a larger oboe, with the upper part bent. Its tone is rich and beautiful, and is especially effective in mournful passages. The bassoon, the bass of the oboe, is sometimes called the clown of the orchestra because when its deep tones are produced with extreme agility they are irresistibly grotesque. In ordinary use it supplies the bass of the entire wood-wind group. It is so long that its tube has to be bent back upon itself, bringing what we would naturally call the lower end to a position above the mouthpiece. The double reed is fixed to a crooked mouthpiece several inches in length coming from the side of the instrument.

The clarinet is larger than the oboe, and its tube is straight, not conical. Its mouthpiece is cut into almost the shape of a chisel, and has a single thin flat reed. Its voice has three distinct qualities, the lower tones being dark and gloomy, the middle tones full and liquid like a soprano voice, and the highest fierce and shrill. In fullness and variety of tone it is the chief of wind instruments, and hence is the leading instrument in military bands. The bass clarinet is a much larger and deeper-toned instrument. The top is bent to accommodate the player, and the lower end is bent back upon the body and has a decided flare, or bell.

In general, the wood-wind instruments have a softer tone than the metal horns, or "brasses" as they are called. The tones best described as "blare" are absent, being replaced by more plaintive overtones. For this reason they blend better with stringed instruments. (*See* Musical Instruments; Orchestra.)

The ANCIENT ART *of* WORKING *in* WOOD

How Plain Carpentry Gave Rise to Many of the World's Arts and Trades—Pharaoh's "Gang Boss" Lives in Wood After Forty Centuries—The Place of the Machine in Wood-Working

WOOD-WORKING AND WOOD-CARVING. Long before man was civilized, he had learned to shape wood into weapons, huts, boats, ornaments, and useful objects. After the dawn of civilization, the wood-worker gained in skill and importance. Early in history people had invented the saw, the chisel, the ax, and the auger. Skilled wood-workers carved idols and decorations for houses and temples, made furniture, chariots, boats, spears, bows and arrows, and household articles.

From simple carpentry, the earliest sort of wood-working, developed many arts and trades: wood-carving, furniture making and repairing, wood-engraving, pattern making, cooperage, wheelwrighting, shoe-lasting, wood-turning, and coach-building. Machinery has made great changes in all wood-working trades, and eliminated much hand labor.

Of course, machinery plays no part in the carving of statues or ornamental works of art from wood. Among the most precious possessions of the world's museums you may find the beams of some quaint half-timbered house, or articles of domestic furniture. Not alone for their intrinsic value are they treasured, but also because they represent artistic craftsmanship and hence are inspiring models for all wood-carvers today.

Like sculpture in stone and marble, a wood-carving is the result of cutting away the material until the remainder has the shape which the artist intends. Unlike stone or marble sculpture, wood-carving, from the perishable nature of the material, is doomed to a relatively short life. Yet some remarkably old examples of wood-carving have been preserved. Few more vital works of portrait sculpture exist than an Egyptian figure of wood, called 'The Village Chief', which dates to about 2700 B.C. Fine linen was glued over the wood and stucco was rubbed in to give a smooth surface, which was painted. Insets of rock crystal formed the eyes. This misnamed work probably portrays an ancient "gang boss," or overseer of workmen.

'VILLAGE CHIEF'

A wooden statue carved 4,600 years ago in Egypt.

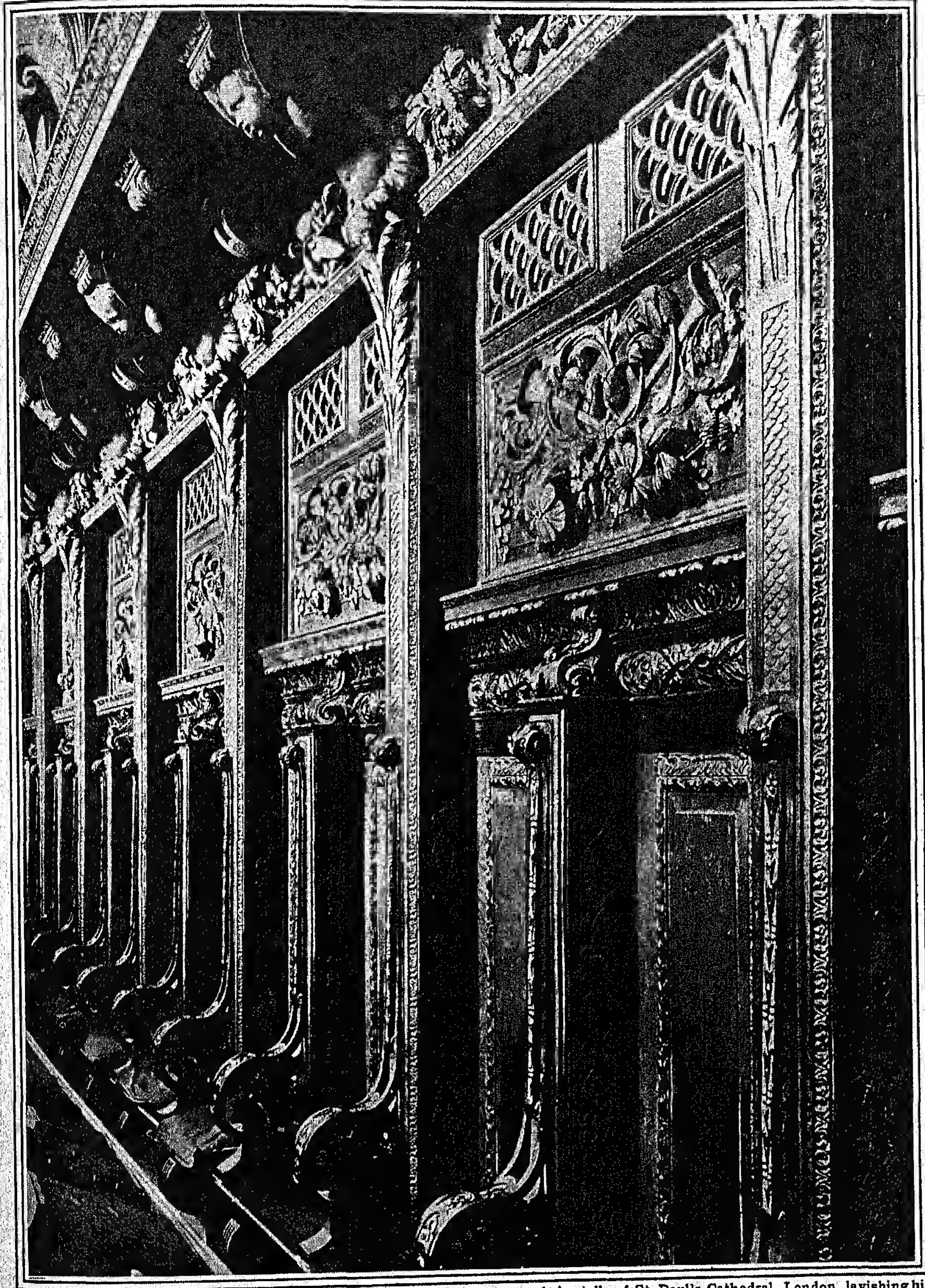
The 15th century in Europe saw the wood-carver's art rise to the highest levels in technique and expression. This was due to the ease of handling wood, and to its adaptability to daily needs.

Nearly every variety of wood, soft and hard, has been used for carving. The first essential is an even and close texture, so oak has been universally popular. The wood may be soft or hard. Many of the exquisite flower, fruit, and leaf carvings of the Englishman, Grinling Gibbons, (1648–1720), are of lime wood.

It is of no importance whether the grain is conspicuous or not. Here, as elsewhere, the true artist chooses his material for its suitability to the work in hand. The direction of the grain in Mestrovíc's 'Christ Driving Out the Money-Changers'

THE INTERLACED CARVINGS OF MOHAMMEDAN ART

Skilled wood-carving is done in many Mohammedan countries, and much of it displays a geometric interlaced design such as we see in this 18th-century Damascus chest front, carved in low relief, preserved in the Metropolitan Museum of Art, New York.



The noted English wood-carver, Grinling Gibbons, wrought the elaborate choir stalls of St. Paul's Cathedral, London, lavishing his faultless technique upon a Renaissance design with a profusion of fruit, flowers, horns, and classic details.

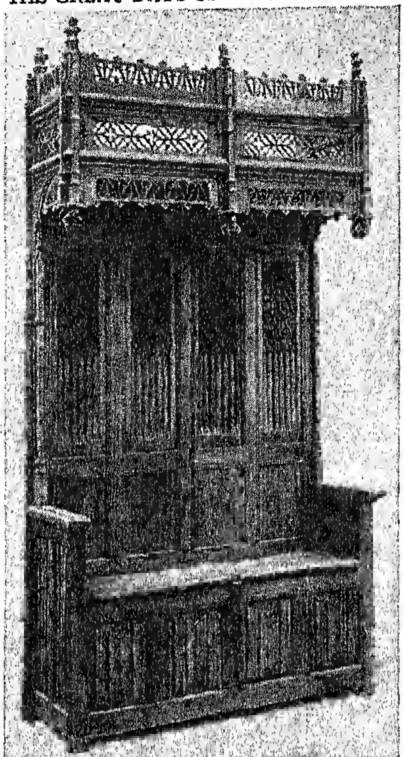
has been utilized to accent the elongated lines of the figures, and emphasize the movement of the design as a whole.

Painted and Gilded Carving

In connection with material, it should be borne in mind that many of the finest works of wood-carving, from the earliest times, have been painted and gilded. In this, as in other important respects, the art took its lead from contemporaneous work in stone and marble. Greek marble and Gothic stone were generally painted and gilded. Many of the world's great artists have avoided leaving raw material in their finished works.

Tastes have varied from age to age and from nation to nation in the appreciation of unfinished material, such as wood or stone. Carved wood, when the dimensions of the work are small and the design intricate, cannot be seen to the best advantage except when painted or gilded. Lacquered, gilded, and painted wood-carving in India and China is of great beauty. However, plain surfaces of natural wood have charm.

THE GREAT DAYS OF WOOD-CARVING



The world's finest wood-carving was done in the 15th century. This Flemish canopied seat shows the beautiful linen-fold paneling.

Few things that the wood-carver has ever done are more indicative of clever artistry and design or more fascinating than the decorated framework of beams in the 16th-century houses still standing in many an old town on the Continent and in England. This framework of uprights and crosspieces, and the sloping sides of gables, are often one mass of leafy forms interspersed with birds, squirrels, and other small animals. Here a grape vine, all leaves and bunches of fruit, twines along the eaves, and there a hop vine climbs to the very top of a lofty gable. At Angers, in France, there is a fine house whose angle support is a huge log carved to represent a tree in leaf and fruit.

ORIENTAL CALM

Buddhistic calm lingers in the lines of this Japanese statue of the 12th or 13th century.

The variety of invention in this "domestic" work is as endless as the charm of it is great, giving a feeling of intense vitality such as Austin Dobson must have had in mind when he wrote:

Where a wistful man might look,
Finding something through the whole,
Beating—like a human soul.

The subject matter of the wood-carver has been either decorative, as in the plant forms and in the geometric lacings of the Mohammedans and Scandinavians; or spiritual, as in the fetish art of the African negroes, and the numberless lovely saints and madonnas, colored and gilded, which have come to us from the greatest of all wood-carving epochs, the 15th century in France, Flanders, Germany, and England. In the best statues of this time, large and small alike, spirituality and personality are expressed with exquisite delicacy and tremendous force. The most intense feelings of joy, grief, or calm are stamped upon the wood, often further enhanced by color. Grace and truth of nature are shown in plant and bird and insect with scientific precision. The design, of which these are but parts, is subjected to the inescapable laws of composition and harmony, which govern truly artistic minds always and everywhere.

The Old Art of Wood-Engraving

Wood-engraving is a trade, or an art, greatly altered by machinery and changed tastes. Years ago, the easiest and quickest way to reproduce pictures in books and magazines was by making a wood-engraving or woodcut. The engraver first drew the picture on a smooth, hard block of wood, then cut out the wood around the lines of the picture, so as to leave the lines higher than the background. These lines, when inked, would print the picture. Many old woodcuts were very beautiful, but they required much time and skill. The modern newspaper

GAIETY TOLD IN WOOD

This lively dancer, whose draperies fairly move, was carved about 1480 by Erasmus Grasser for the old town hall in Munich.

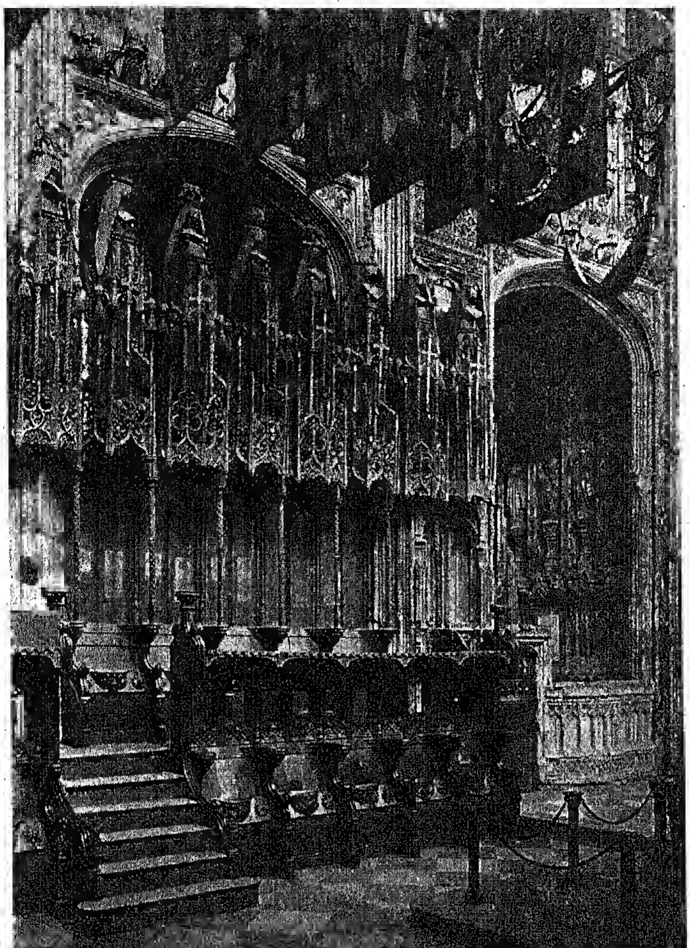
and magazine demand a faster method. Pictures are engraved on metal by photographic, mechanical, and chemical processes. Woodcuts are today used only for special artistic effects. (*See* Engraving and Etching.)

The old coopers, or barrelmakers, have also been replaced by the machine, for handmade barrels are rarely used. The machine today turns out boxes and crates, and releases the skilled hand craftsman for tasks more worthy of his skill. The carriage-maker has also been superseded by the great automobile factories.

Shoe lasts, once all made by hand, now need have only one model from the hand of a skilled craftsman. This model is then reproduced in large numbers by a copying lathe. This has a spindle, which maintains contact with the model, and shifts the position of the cutting tool as the operation proceeds, so that the cutter produces an exact copy of the model. The copies are used as lasts over which the shoe leather may be shaped. Automatic wood-turning machines have driven out wood-turning by hand, except for making patterns for cast iron and other metals. Skilled mechanics cut the casting models in white pine. Then wet sand is packed around them. When the wooden model is removed, the sand holds its shape and the molten metal is poured into the hollow.

Even the carpenter who builds our wooden houses and puts in place the woodwork inside them is finding more and more of his work done for him by the machines of the planing mill, and in his own work he makes increasing use of machines, such as saws driven by electric motors. The cabinetmaker is rapidly becoming a machine worker rather than a hand craftsman. Furniture was once all made by hand, but today electrically driven machines both for producing single pieces of furniture, and in making parts for many pieces of the same kind, are being used for practically all the operations. Machines can do beautifully much of the "donkey work" which hand labor could not do better; but they can never give the artistic touches, the irregular charm, which lends such beauty to skilfully done hand decoration.

LATE GOTHIC CARVING IN WESTMINSTER ABBEY

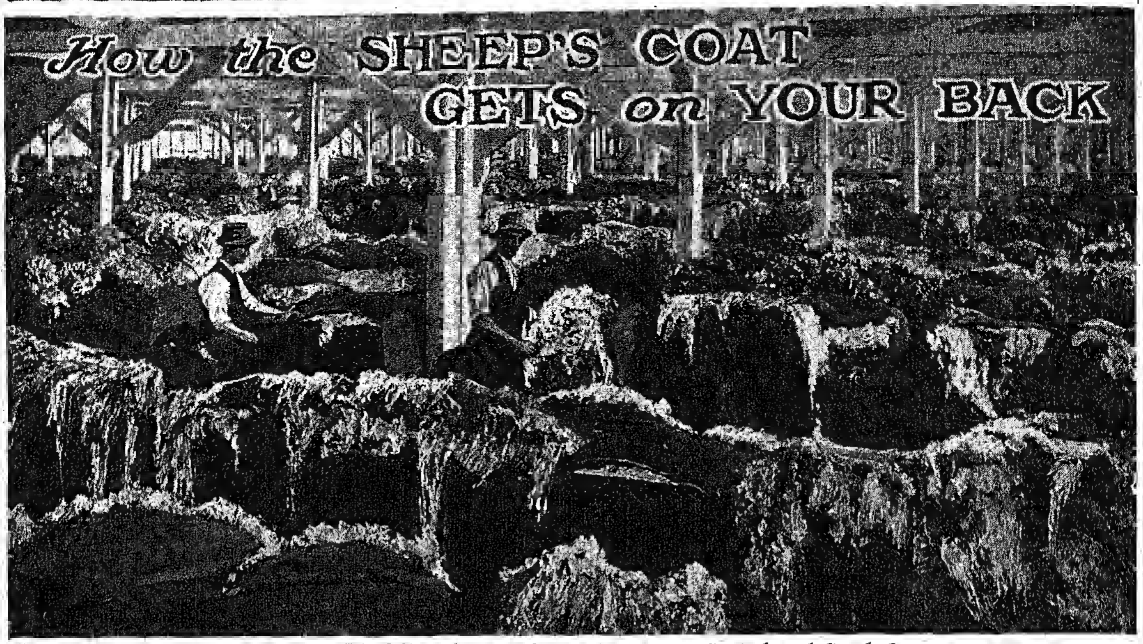


In the famous chapel of Henry VII in Westminster Abbey, each stall, assigned to a Knight of the Order of the Bath, displays elaborate carving of the late Gothic flamboyant style. On the seats, and the squires' seats below, the carving is of the later Renaissance style.

It is significant to note that, with the coming of the machine, creative work in furniture design stopped. The great cabinetmakers, Chippendale, Sheraton, Hepplewhite, and others, were men of the handwork era. (*See* Interior Decoration.) The only new note in cabinet making has been brought about in very recent years in the so-called "modernist" style, which results from a proper understanding of the machine, and gives it only such work as a machine may suitably do. Many simpler pieces of older design may also be made satisfactorily, and of course at much less expense.

Wood-working, whether done by hand or with the machine, involves only a few fundamental operations: planing or shaving, boring, scraping, cutting, or splitting. Planing is done by the plane, the spoke-shave, the draw-knife, and sometimes the chisel; boring by auger bits and drills; scraping by steel and sandpaper; cutting by knives, chisels, and saws; splitting by knives, axes, and the like. Wood-working machines are simply more elaborate forms of these ancient tools. Many of them work in "gangs," shaping or carving several duplicate pieces at the same time. Other operations are shaping, done by steaming the wood, then molding it to shape under pressure; veneering, or covering a cheaper wood with a thin layer of a more expensive kind; and inlaying.

How the SHEEP'S COAT GETS on YOUR BACK



A Great Wool Storehouse where Fleeces are Sorted and Graded

WOOL. Because it effectively keeps in the heat of the body, woolen garb is the most comfortable in northern climes, and wool has become the characteristic clothing of the Western World, as cotton is of the warmer East. Since the introduction of machinery the use of wool in the United States has increased from three to five pounds for each person—a little less than the average annual "clip" from one sheep. And even this would not be nearly enough to go around if much of the pure wool were not mixed with cotton, and if the supply of new wool were not supplemented by the used wool gathered by armies of "old clothes men" and ragpickers the world over.

The presence of cotton in woolen cloth is not always a disadvantage, since it is useful in strengthening cheap and tender woolens. Such mixed material is, however, sometimes sold as "all wool," and it is difficult for the customer to detect the adulteration. One of the easiest tests is to bite a single thread. Wool is harsh and tough between the teeth, while cotton is soft and crushes. The fibers may also be distinguished by unraveling a piece of the warp and filling threads, being sure to untwist all double ones, and then burning each thread separately. If it chars and swells, gives forth a greasy odor, and refuses to carry the flame, it is wool; but if it burns without a greasy odor and carries the flame freely, it is cotton. Sometimes, however, the fibers have been blended before spinning, and a more elaborate test must be used. Boil a sample in a strong caustic soda solution; the wool will dissolve, but the cotton will remain.

The presence of "shoddy"—remanufactured material—is more difficult to detect. Shoddy fabrics may be all wool, but the reclaimed fibers are shorter and weaker and will not wear so well. Since shoddy is made up of variously colored cloths, the best test is to examine the fabric with a magnifying glass, and if one piece of yarn is found to contain fibers of a number of colors, the presence of shoddy is certain.

The name "wool" is properly given only to the fiber of the domestic sheep. Other fibers so closely resemble it, however, that they are also called wool in commercial usage. We get mohair from the Angora goat, cashmere from the Cashmere goat of India, and alpaca from the animal of that name which ranges in the South American Andes. The difference between wool and hair is one of degree rather than kind, the wool fibers being commonly finer, softer, and curlier, with innumerable minute scales—from 500 to 2,800 to the inch—which overlap one another like shingles. The curl keeps the yarn from unwinding, and the scales interlock and hold the fibers together. These properties are also used in making felt, which is done by simply rolling or pressing a pulpy mass of wool into a flat mat (*see* Hats and Caps). The elasticity of wool is another distinctive quality, giving woolen fabrics pliability and softness.

Much attention has been paid to breeding sheep for wool. The finest wool is produced by the Merino, a native of Spain which is now found all over the world. It has a short staple, however, and has been crossed with high grade long-wool breeds to develop the highest type of wool fiber. (*See* Sheep.)

Wool is shorn from the sheep ordinarily each spring, or sometimes twice a year in places of continuous hot weather. Hand-power shearing machines, with which a shearer and his assistant can clip only from 35 to 75 sheep a day, are being replaced by electric machines, or, when electric current is not available,

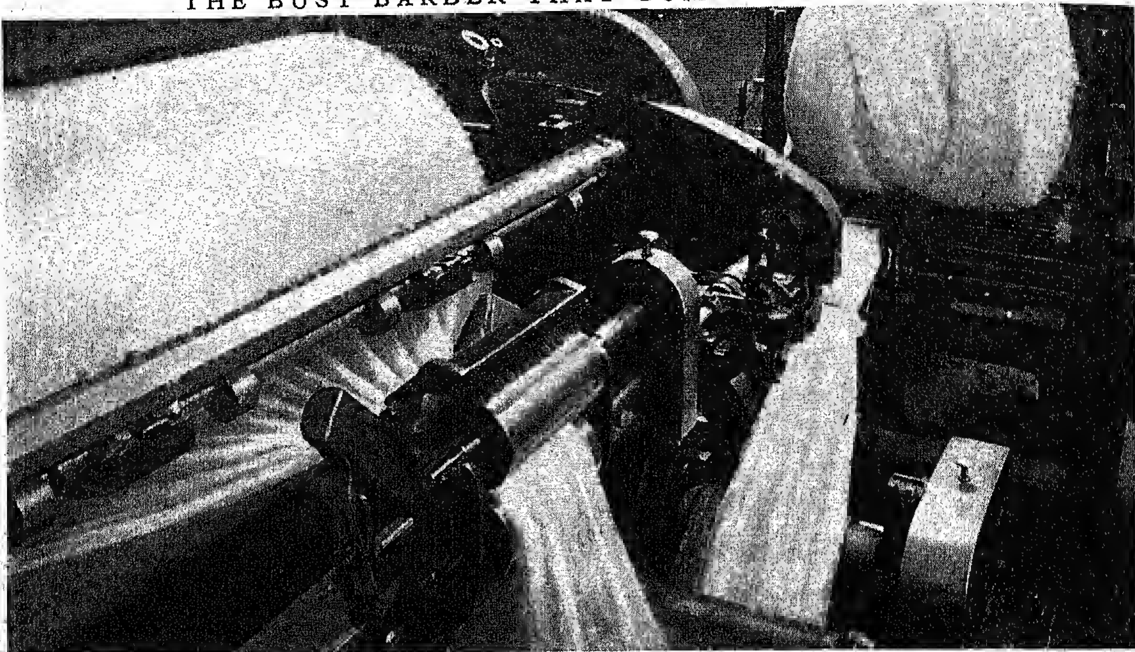
Continued on page 145

THE PICTURE STORY OF WOOL—SHEARING AND CLEANING

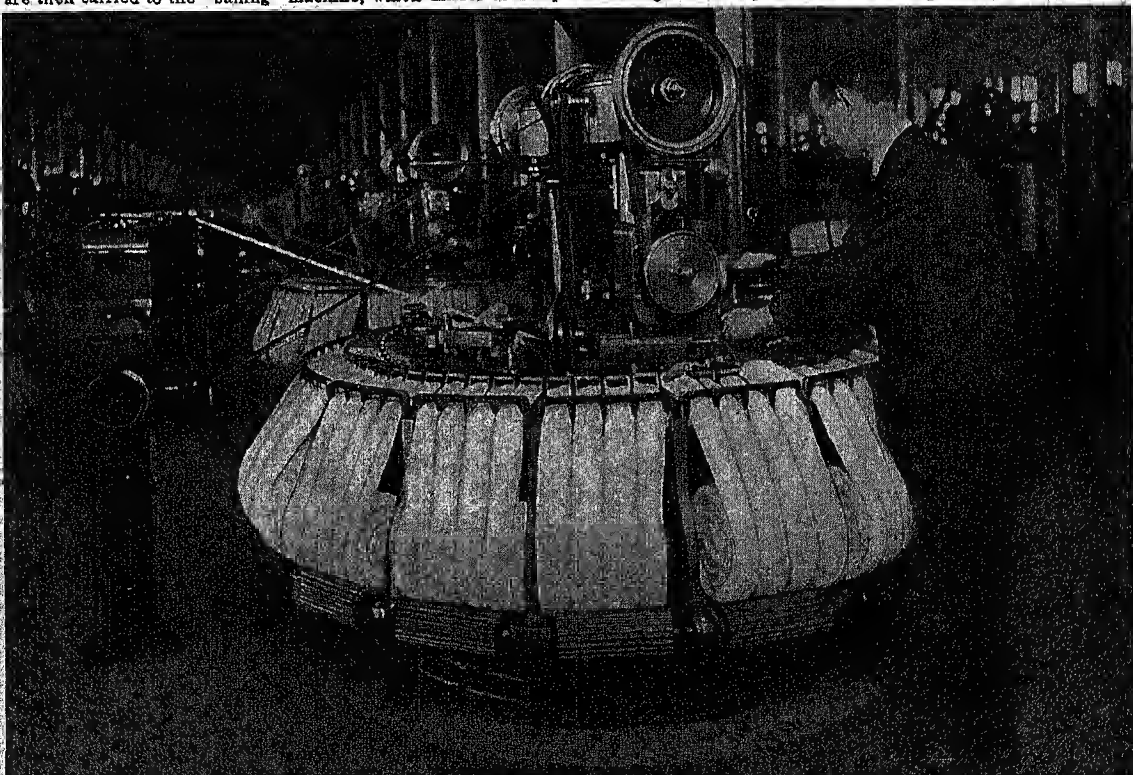
In less time than it takes a man to shave his face, an expert shearer can clip a whole sheep, as pictured at the left. The clippers are driven by a flexible shaft from a motor, which is carried in the car from ranch to ranch. The matted wool, as you see, clings together and comes off in a single piece like a coat. This fleece is packed with others and sent to a warehouse. In the warehouse pictured at the right are piled sacks and bales of "grease wool," as it is called before the oil secreted from the sheeps' skins has been washed out. Sacks and bales weigh from 100 to 500 pounds, half of which may be grease and dirt.

The wool next goes to the mill. Here the fleeces are torn apart and their fibers are carefully sorted. Then the wool is conveyed by automatic rakes through a washing machine which contains vats of warm, soapy water. Rollers wring the water from the wool as it passes from vat to vat. The picture above shows the wool emerging snowy white from the machine.

THE BUSY BARBER THAT COMBS THE WOOL

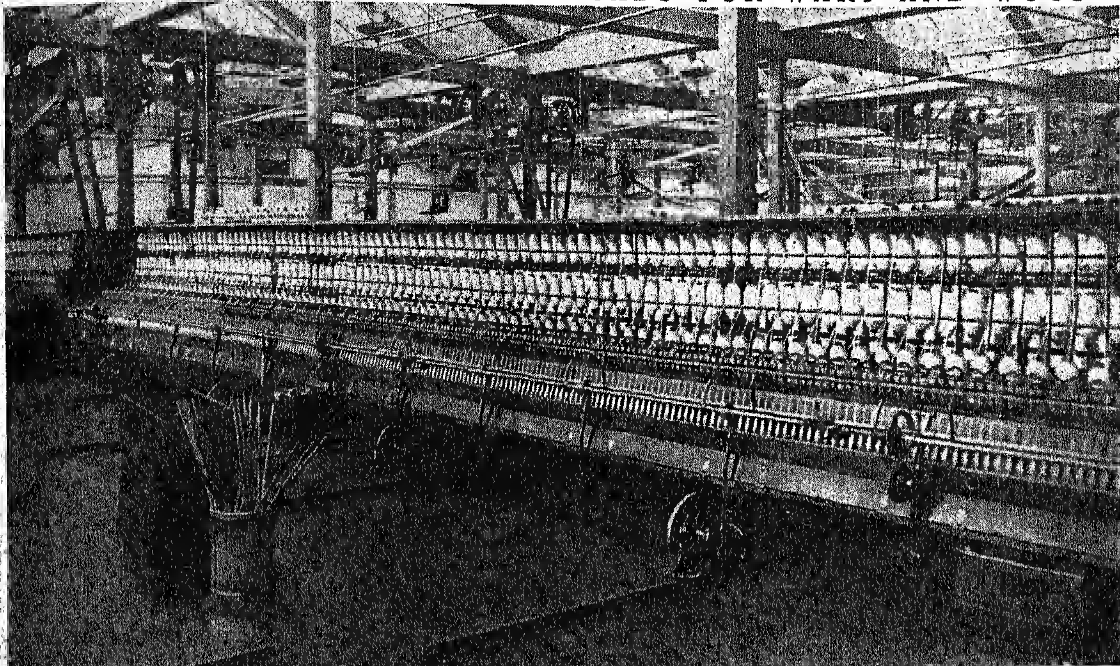


After the wool has been washed, it is carded. In this process the fibers are straightened by running between rollers with tiny teeth, revolving in opposite directions. These catch and separate the fibers. The wool is wound off into a "sliver" or loose ball, which goes to the "gilling" machine. This machine straightens the fibers, which come out in the form of soft strands. Four of these strands are then carried to the "balling" machine, which makes them up into a large ball. Eighteen balls are required to fill a "comb."

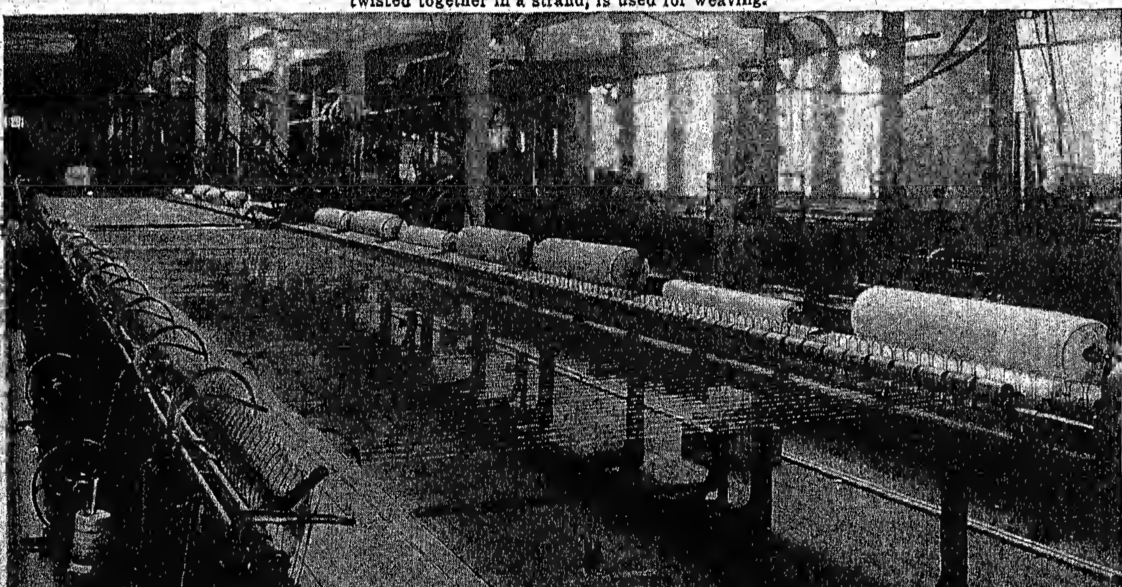


This is a comb filled with the 18 balls. This mechanical barber removes all the short stock or "nibs" and combs the long fibers so straight that they are parallel to each other. When the combing is finished, the sliver makes two more journeys through the gilling machine and is once more wound into a ball called a "finish top." The fibers are combed only in making worsteds, not plain woolens. But, whether worsteds or woolens, up to this point no twist has been given to the wool and it has no appearance of thread.

TWISTING SLIVERS INTO THREADS FOR WARP AND WOOF

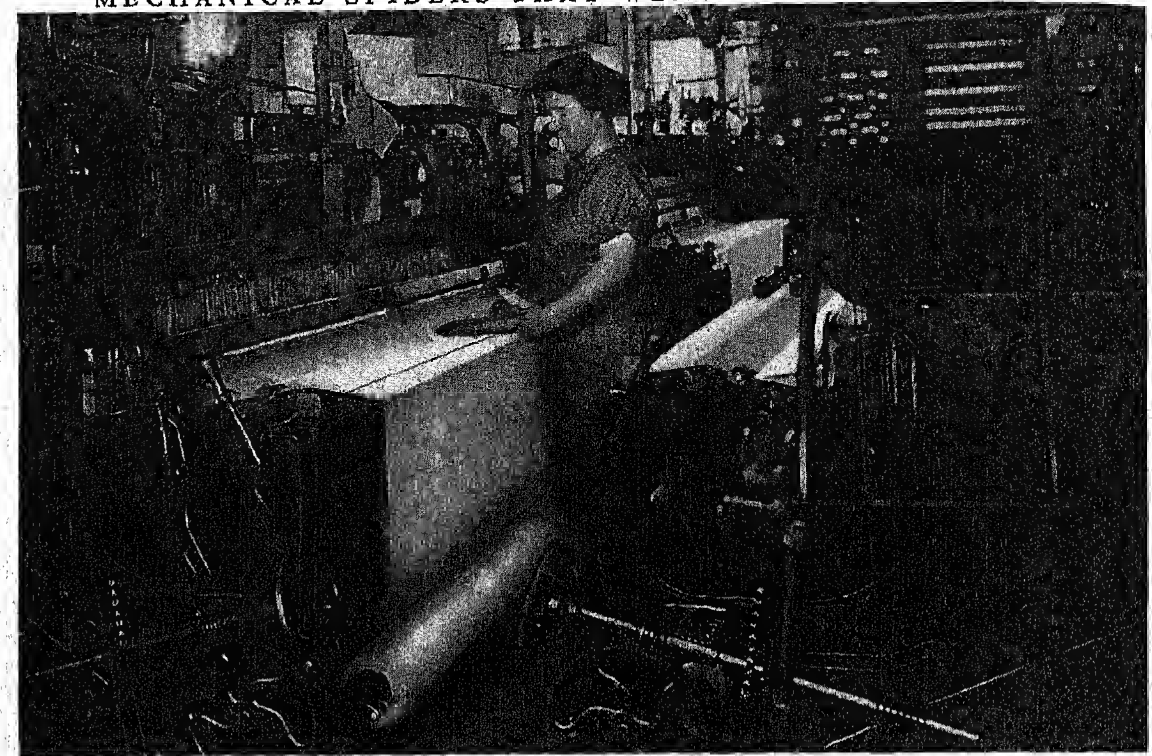


The soft straight wool then takes its first merry-go-round ride. It is run through a machine which twists and draws it into thread, and then it is put through the long spinning machine which you see in the illustration. Here the same process continues until the twisted thread has been drawn to the required size. This twisted thread, sometimes singly, sometimes with three or four threads twisted together in a strand, is used for weaving.

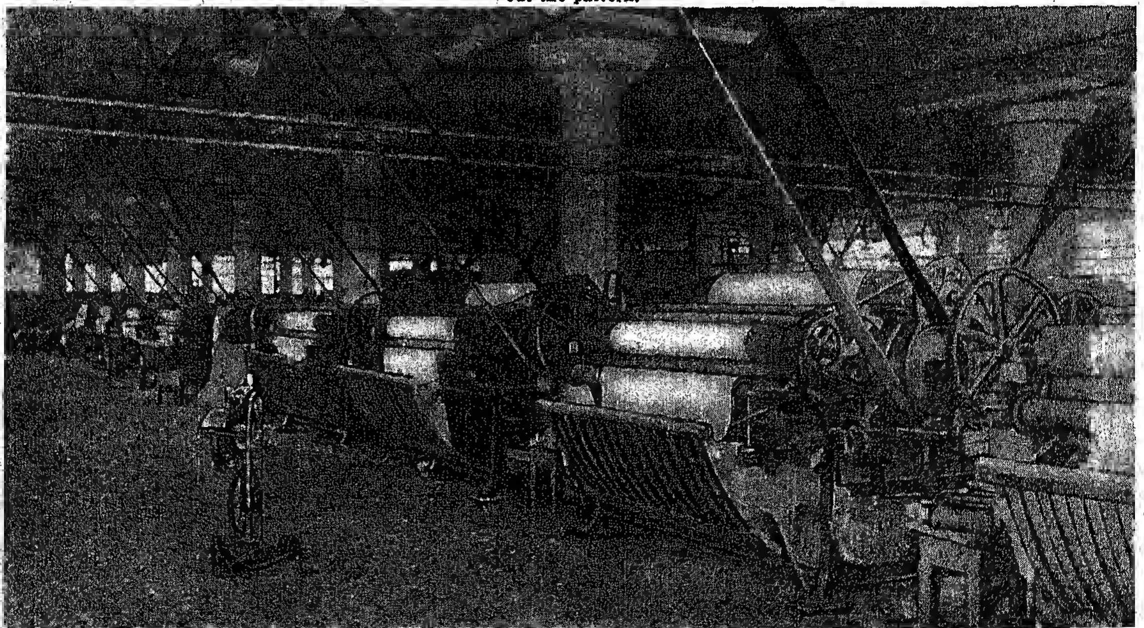


Here is another kind of spinning machine, known as a "mule." The carriage containing the spindles travels back and forth on a track. If the wool was not dyed when it was in the form of a "finish top" it is usually dyed at this stage, as a more uniform color can be obtained in this way than if the finished piece is dyed. The yarn or thread is now carefully inspected, and any imperfections which would show in the finished goods are removed. The thread is now ready to be used either as warp (lengthwise thread) or woof (crosswise thread), depending on its quality and character.

MECHANICAL SPIDERS THAT WEAVE THE WOOLEN WEB



Modern machinery seems to operate consciously, almost as if it were some highly developed animal or even a human being. If you could watch this great loom perform its duties you would be wonder-struck. While the warp threads were transferred to the warp beams, the woof threads were put on shuttle bobbins, which carry the woof thread across the loom. When the warp beam has been properly harnessed and the weaving is started, the loom operates by what is called a "head motion." This is a mechanical device for raising some of the threads and lowering others, so that the woof shuttles, passing above some threads and below others, fill out the pattern.



These "napping" or "gigging" machines are used to finish woolens. They pluck or raise the ends of the fibers on the face of the cloth by means of a "teasel," a wire brush shaped somewhat like a pine cone. When the nap has been raised to the proper length, it is sheared by a machine which works on the principle of a lawn mower. Worsted cloth is finished by passing through a brushing machine, which lifts the long fibers, and is then sheared just like woolen cloth. Lastly the cloth is pressed or ironed, and it is then ready for measuring, weighing, and packing for the market.

by machines driven by a gasoline engine. With these power-driven machines expert shearers can handle from 150 to 300 sheep a day. The first clip, called "lamb's wool," may be taken when the lamb is from 6 to 8 months old. The fleeces of the older sheep are called "fleece" or "territory" wool. Wool from the pelts of sheep killed in slaughterhouses is called "pulled" wool and is inferior to the shorn wool obtained from live sheep.

After shearing, the fleeces are rolled up in bundles and sent to the mill, where they must be sorted. Not only do the various kinds of sheep furnish widely different qualities of wool, but different qualities are obtained from the same animal. The best wool comes from the sides and shoulders. That cut from the head and chest is irregular and likely to be filled with burrs, and that from the lower parts of the body is usually short, worn, and dirty.

Although the fleece may have been washed on the sheep's back by the farmer or flockmaster it still has to be scoured. Scouring rids the wool thoroughly of the stains of earth and dust which it has picked up, and the greasy matter, called "yolk," secreted by the skin of the animal. The wool is then dried and is ready for "mixing"—the blending of several qualities of wool—to produce cloth of the desired quality. If other materials are to be mixed with the wool—as silk, cotton, or shoddy—they may be added at this stage. Usually, however, they are twisted with the wool yarn after spinning, or combined in the weaving.

The wool is now oiled to restore its natural pliancy, and is ready for "carding," an operation which pulls the fibers apart so that they lie loosely, separated in a uniform film. This is done by revolving cylinders covered with leather strips in which fine long wire teeth are fixed. If the wool is to be used for "worsteds" it must be combed in addition to being carded, to make the fibers lie parallel to one another, so that the threads when spun will be regular in shape and hard and compact. The wool for "woolens" is not combed, but after emerging from the carding machine in light strands called "rovings," goes directly to the spinning room, where the mixed and matted fibers are spun into a soft loose irregular thread.

Spinning the Yarn

In the spinning room the fibers are drawn out and spun into a single yarn. The yarns are then twisted into two, three, or four strands, or used singly, depending upon the coarseness or fineness of the fabric to be made. Soft fragile yarn is often used for "weft" or "filling," but the warp threads must be able to bear much greater strain, and are twisted harder. (*See* Spinning and Weaving.) Formerly nearly all woolen goods were dyed after leaving the loom, but now the practice is becoming more general of dyeing the yarn before spinning.

After the cloth leaves the loom another series of operations begins. First the material passes under the inspection of young women who with needle and thread make good any defects of knotted or broken yarns. Then the cloth is saturated with hot water and soap and rubbed between slow-revolving rollers for many hours to give the amount of shrinkage desired. This process is known as "fulling" or "milling." The soap is then washed out and the cloth is stretched so that it may dry evenly. Next the nap is raised in a "teaseling" machine by means of thousands of little steel hooks which scratch the surface, and then trimmed by a very fine machine which acts on the principle of the lawn mower. After being pressed between hot plates and dry-steamed to impart luster, it is finally ready for market.

Wool Production and Artificial Wool

The United States wool "clip" averages about 300,000,000 pounds a year, most of which comes from the big flocks of the sparsely settled western states. This is only about one-half of what the country's mills and factories require; so the rest is made up from imports, chiefly of low-grade "carpet" wools from the Orient. The wool-manufacturing industry is centered in Massachusetts and Pennsylvania. The world's largest wool producer is Australia.

Artificial wool is the name given to certain artificial fibers, having some of the qualities of wool, which have been developed in Germany and Italy to lessen dependence on foreign sources of supply. The Italian wool substitute, called *lanital*, is made from casein in much the same way as rayon is made from cellulose (*see* Rayon).

WORCESTER (*wos'tẽr*), MASS. If ever any city might properly call itself the cradle of invention, it is Worcester, the second largest city in Massachusetts. Within 15 miles of this city's municipal building were born Eli Whitney, the inventor of the cotton gin; Erastus Bigelow, inventor of the carpet-weaving machine; Elias Howe, inventor of the sewing machine; Lucius Knowles, who perfected the modern loom; and the three inventors, Draper Ruggles, Joel Nourse, and J. C. Mason, who perfected the modern plow and devised many other improvements on farming implements.

Conspicuous in Worcester's wide range of manufactures are wire and wire products, textile and other machinery, carpets and rugs, crankshafts, street and railroad cars, electrical apparatus, leather goods, envelopes, firearms, grinding wheels, and machine tools. The city is also one of the leading distributing centers of New England.

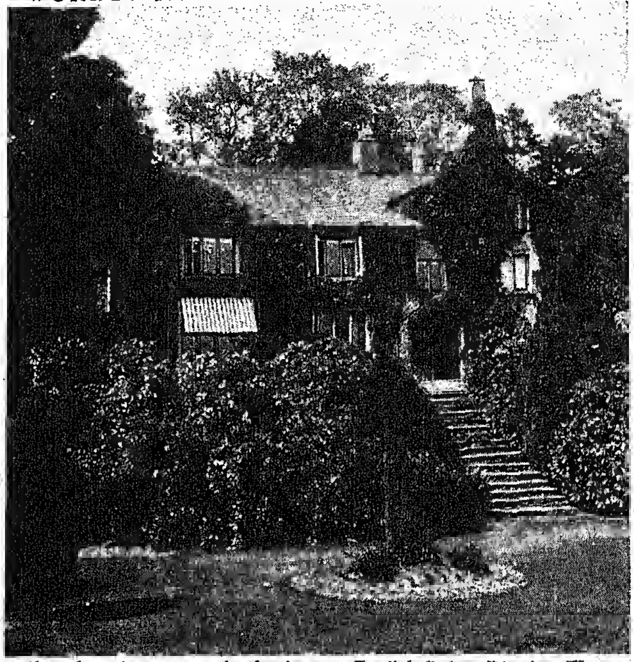
Worcester was first settled in 1673, but was twice abandoned on account of trouble with the Indians. But in 1722 it was incorporated as a town and in 1848 chartered as a city. In 1775 Isaiah Thomas moved here from Boston with his paper *The Massachusetts Spy* and made Worcester an important publishing center during the War of Independence. The city today is an educational center, housing Clark University, Assumption College, the College of the Holy Cross, the Worcester Polytechnic Institute, a state normal school, and Worcester Academy. The library of the American Antiquarian Society, founded in 1812, contains a rich collection on American history and some interesting portraits.

Northern Europeans and Canadians form the largest proportion of Worcester's many foreign-born residents. Population (1940 census), 193,694.

WORDSWORTH, WILLIAM (1770–1850). William Wordsworth, the interpreter of nature, the great poet-lover of humanity, and the leader in the poets' revolution back to simple truth and beauty, was born April 7, 1770, at Cockermouth, England, a little village on the River Derwent among the beautiful hills of Cumberland. He came of a family of landowners, and from his earliest days had a deep love for simple country life and for the beautiful region in which he lived. In this outdoor wonderland the serenity of the murmuring Derwent, of the sounding cataract, of forest shadows at noonday, a mountain peak at dawn, or lonely "waters on a starry night" were woven into the very depths of his being.

Wordsworth took his degree at Cambridge University in 1791, without any particular distinction. His life was singularly uneventful except for visits to the Continent. It was on the second of these that he threw himself fervently into the cause of the French revolutionists and was just about to join the Girondins when his disapproving family stopped his supplies, and the lack of money brought him home toward the close of 1792. For three years he lived in an unsettled fashion without prospects or profession until, upon receipt of a legacy from a friend, he took a cottage in Dorsetshire with his sister Dorothy, resolved to devote his life to poetry.

WORDSWORTH'S HOME AT RYDAL MOUNT



In this charming cottage in the famous English Lakes District, Wordsworth lived from 1813 to 1850. It was only on rare occasions that he left it even temporarily, and he always returned to it with joy. With him lived his wife and his beloved sister Dorothy, and not many miles away was Southey, one of his closest friends and his predecessor as poet laureate. Wordsworth, Southey, and Coleridge were the original "Lake" Poets, whose work marked the beginning of the Romantic movement in 19th century English literature.

Wordsworth's life from this time on was one of "plain living and high thinking." In 1797 the poet settled at Alfoxden in Somersetshire, where under the stimulating friendship of Coleridge he began his really important writing. The two poets wandered, talked, and walked and worked together, producing in 1798 their famous collection of 'Lyrical Ballads'. In the second edition of this anthology Wordsworth startled the literary world by declaring that poetry was the "spontaneous overflow of powerful feelings," and that poets should have for their creed simple scenes, everyday words, truth to nature, and imagination. In the book itself were such splendid applications of this creed as Coleridge's 'Ancient Mariner', and Wordsworth's 'Lines above Tintern Abbey', 'Michael', and 'The Revery of Poor Susan'.

In spite of the ridicule which his themes and his frequent lapses into commonplace provoked, Wordsworth kept on writing for the rest of his long life, composing many very dull and a number of very beautiful poems, and doing most of his best work by 1807. He made his home for the last 50 years of his life at Grasmere and Rydal Mount in the Lake Country in the North, where, in 1802, he married his cousin, Mary Hutchinson. Gradually he won public favor, and was made poet laureate seven years before his death in 1850.

In his long poem 'The Prelude' this serene poet gives an account of his mental growth and tells how his boyish love of nature's physical beauty changed to an appreciation of the tranquillizing spiritual kinship between Nature and man. "To me the meanest flower that blows can give thoughts that do often lie too deep for tears," he cries. In many of his simple and beautiful poems Wordsworth reveals to us the beauty, harmony, and sublimity of Nature. Wordsworth is undramatic and lacks broad sympathy with human nature. But his best nature poems, a number of his exquisite sonnets, and several of his simple and touching peasant poems in which he lifts the commonplace into genuine poetry, are immortal. As Wordsworth's poetic disciple Matthew Arnold puts it: "Wordsworth's poetry is great because of the extraordinary power with which Wordsworth feels the joy offered us in Nature, the joy offered us in the simple affections and duties; and because of the extraordinary power with which he shows us this joy, and renders it so as to make us share it."

Wordsworth's finest poems are 'The Solitary Reaper', 'Michael', 'Lines above Tintern Abbey', 'Daffodils', 'Intimations of Immortality', some of the 'Lucy' poems, 'Westminster Bridge', 'The World is Too Much with Us', and 'To Milton'. His published works include: 'An Evening Walk' and 'Descriptive Sketches' (1793); 'Lyrical Ballads' (1798); 'Poems' (1807); 'The Excursion' (1814); 'The White Doe of Rylstone' (1815); and 'The Prelude' (1850).

WORKING CONDITIONS *and* WORKING EFFICIENCY

WORK AND FATIGUE. Under what conditions does the individual work most effectively? What are the factors which make for efficiency? What factors work against efficiency? How long should a person work? What is the relationship between work and sleep, between work and fatigue, between work and other conditions such as ventilation, distraction, temperature? These are interesting and practical problems, both to the worker and to the employer.

If we set someone at a job and keep him at it continuously without rest, ultimately he will break down and be unable to go on. If rest intervals or changes of activity are introduced, the person will be able to work for a much longer period of time. Efficiency, then, seems to be in large part a matter of the distribution of work and rest periods. In ordinary life there is regular alternation between work and rest. We work during the day, and sleep at night. We continue to alternate between work and rest, year in and year out.

Suppose now we consider a single period of work. We notice first that the worker is less efficient at the very beginning than he is after working a short time. This phenomenon, called "warming up," is found in many different activities. The baseball pitcher who goes into the box "cold" is less efficient than the pitcher who has warmed up. Some pitchers need a long warming-up period and others need a short period. The speed with which the point of highest efficiency is reached varies from individual to individual.

When We "Let Down"

After warming up, the worker reaches a high level of performance which continues for some time. Then his efficiency begins to fall off, and the longer he works the less he is able to produce. The time at which this drop comes varies with different activities, and at different times in the same person. Some pitchers "blow up" in early innings and some pitch a whole game without loss in effectiveness. Usually the more strenuous the activity, the sooner occurs the falling off. The drop is more marked when a simple and monotonous task is carried on at a high rate of speed, than in a complex and involved task.

But now suppose our worker who has been on the job all morning, knows that he is to stop at twelve o'clock. Usually there will be an increase in efficiency just before the work period is completed. This is commonly known as the "end spurt." When the worker realizes that he is almost through he settles down to his task with new interest and incentive.

If we carry on any physical activity for a long period of time we become tired and stop. Under exceptional conditions, where motivation is unusually strong, as for instance, in an emergency, the ordinary indications of fatigue may be neglected. But usually they are heeded. If high efficiency is to be maintained, rest periods must alternate with work. In certain industrial plants interesting studies of the distribution of rest periods have been made. In one factory where men were hauling pig iron in wheelbarrows, no man obtained the bonus for exceeding the minimum requirements of the job, when left to himself to work as he wished. All were so interested in the bonus that they kept right on working and quickly became fatigued. But when a foreman blew a whistle every 12 minutes, at which each man stopped, sat down, and rested for 3 minutes, it was found that all the men earned the bonus. At the end of the week it was found that the men earned on the average 40 per cent more than when they worked straight along without rest. Here the introduction of a regular rest period during severe physical labor brought a tremendous increase in production.

Is Mental Work Really Fatiguing?

The question whether mental fatigue exists is much debated. There is no doubt that one wishes to turn aside from mental work which has continued for a long time. Investigations have, however, shown that even over long periods there are only slight decreases in mental efficiency. One investigator multiplied four-place numbers by three-place numbers 12 hours a day for four days. While her efficiency dropped gradually from the beginning to the end of each day, she nevertheless was working very efficiently at the end of the four-day period. However, as a person continues to work he becomes more conscious of other factors in his environment and has a stronger desire to stop. Usually, the simpler the occupation and the more monotonous, the more this tendency manifests itself. The more complex the activity, the longer effective action can be maintained. Practically, it is unlikely that an individual will continue mental work to the point at which it becomes harmful, providing he secures proper exercise, food, and sleep. In general, most individuals work under rather than over their capacity.

Another important factor in both mental and physical work is the speed at which the work is done. Although it is usually supposed that the greater the speed, the greater the fatigue, investigations show that this is not quite the case. For each type of activity there seems to be an *optimum* or best speed, above which the person fatigues quickly and below which he also fatigues or becomes inefficient. Often too slow a speed results in errors that disappear when greater speed is maintained. One of the indications of expert performance is the ability to judge the pace at which the activity is best maintained. The rapid worker is usually the most accurate and the best performer. Possibly this is due to the fact that the rapid worker tries out more different speeds of working and thus finds the one which is most effective, while the slow worker never really discovers what he can do. The ability to work effectively under pressure, without becoming so anxious and excited as to lose efficiency, through false motion and duplication of effort, is one of the most valuable characteristics one can possess.

Obviously, however, the quality of work is as important as the quantity or the speed. No boy who reads 'Treasure Island' cares how long or how short a time Stevenson took to write it. There are many people who could write as much or more within the same period of time, but there is only one 'Treasure Island'. In athletic performances we usually find that good form or quality brings about both the speediest and the most efficient type of performance with the least expenditure of energy and the least fatigue.

Stimulants and Efficiency

Drugs such as alcohol, caffeine, tobacco, and the habit-forming drugs produce harmful effects on both the quantity and the quality of work done. Some drugs, such as tobacco and caffeine, have relatively slight effects; with others, such as cocaine and morphine, the effect is very marked. The effect of any drug on efficiency is proportional to the dose; the larger the dose, the greater the reduction in efficiency. It is also true that the effect of a drug is much greater upon a boy or a girl than upon an adult. (*See* Narcotics.)

Poor ventilation has a harmful effect upon the working of the individual, though investigations indicate that the effects are relatively slight if the individual can be motivated to work. In general, poor ventilation makes one drowsy, sensitive, and nervous, with a growing disinclination to work. So too with humidity. As it increases or decreases to a marked degree, there is a growing disinclination to work. If, however, the individual works on, there is relatively little difference in the amount or quality produced. In general, effective conditions for working seem to be around 68° F., 50 per cent relative humidity, and 10 cubic feet of outside air per person per minute.

Never Mind the Rain

Adequate studies on the effect of climate have not been made as yet. But high winds, cloudy and rainy days, seem to disturb our routine. But here again the effect is shown in a disinclination to work rather than in actual inefficiency if the work is undertaken.

As to the time of day at which the individual works most effectively, there seems to be no reliable conclusion. Many people say that they work better in the afternoon and evening than they do in the morning, and other people say the reverse. These seem to be matters of habit based upon the individual's past experience, rather than upon any feature characteristic of the time of day.

Perhaps the most interesting experiments upon efficiency are those dealing with the effects of distraction upon work. By distraction we refer to any outside or interfering stimulus such as a loud noise, a "back-seat" driver, a continuous interfering stimulus. While we would all probably admit that the back-seat driver seriously interferes with the operation of a motor-car, investigations on other sorts of distraction indicate their effects to be much less than the worker ordinarily supposes, if he only keeps at work. The work tends to absorb most of his attention.

In fact, in one investigation a series of loud noises actually increased the efficiency of the workers, by causing them to put forth more effort in order to overcome the distraction. This indicates that, while the effect of a distraction may be relatively insignificant at the time, it is better to save wear and tear on the individual by providing conditions as free from distractions as possible. Obviously, if the distraction actually interrupts the work, there is a loss in efficiency. The schoolboy who has to study in a room with the rest of the family usually gets very little done. A quiet place of his own should be provided.

The Cure-All of Sleep

No discussion of work and fatigue is complete without mentioning sleep, that mysterious process which is so commonplace, and yet so important. In sleep, the toxins and chemical products accumulated in the blood as a result of the day's work and fatigue disappear, permitting the person to rise in the morning refreshed and ready for another day. During sleep there is a reduction in the amount of stimulation received by the person. We shut off the light, pull down the curtains, crawl under the covers, and lie quiet—all of which means that many fewer stimuli are affecting our sense organs. Then the amount of activity is greatly reduced. Although many of us think of sleep as a period of almost complete inactivity, investigation shows this is not the case. Recording instruments attached to beds show that both children and adults are fairly active while asleep, moving on the average as often as once in seven or eight minutes. The activity is, however, less in the early part of the night when one first goes to bed and gradually increases toward morning. The deepest sleep usually occurs about two hours after going to sleep.

In general, investigations on sleep indicate that a considerable amount of sleep is necessary and that the amount varies greatly from person to person. The old saying "early to bed, early to rise" is true; not because late sleep is ineffective, but because the average person does not sleep enough additional time in the morning to make up for the sleep lost by going to bed late the night before. (*See* Sleep.)

The Most Powerful Factor of All

None of these factors, however, is so powerful in determining the quality and the quantity of the work we accomplish as motivation—the spur that drives men on to conquer every handicap and leap over every obstruction. The pages of history are full of the lives of men who worked hard and long under the handicaps of poor health, distractions, disturbing influences, poor living conditions, and who yet achieved a larger measure of success than their fellows who suffered from no such handicaps. But even though strong motivation can overcome the effects of loss of sleep, of bad health, of distractions, of poor conditions, there are definite limits to what motivation alone will accomplish. For long-time efficiency and happiness it is best to observe the principles of health and sound working conditions.

The FIRST WORLD WAR

"Halt"—Road Blocked by Burst of Shell Fire in Path of Advancing Battery

WORLD WAR OF 1914–1918. A map showing the countries at war during 1914–18 would include nearly all of Europe, Asia, Africa, and North America, with Australia and a large portion of South America. No previous war in history had involved so large a part of the earth's area and population. Against Germany, Austria-Hungary, Turkey, and Bulgaria were arrayed 24 nations: Serbia, Belgium, Russia, France, the British Empire, Japan, Portugal, Montenegro, Italy, San Marino, Rumania, Greece, the United States, Brazil, Cuba, Panama, Haiti, Guatemala, Honduras, Costa Rica, Nicaragua, Liberia, China, and Siam. Four others—Bolivia, Ecuador, Peru, and Uruguay—broke off diplomatic relations with Germany. The nations which remained neutral contained less than one-fourteenth of the world's population. The most important of the neutrals were Holland, Spain, Norway, Sweden, Denmark, Switzerland, Argentina, Chile, Colombia, and Mexico.

Not only in numbers involved, but in every other way the first World War made all previous wars small in comparison. The size of the armies and navies raised on each side would have astonished the conquerors of old. The amount of money spent seems fabulous. It has been estimated that the direct cost of the war was about 200 billion dollars, a sum which, if coined into silver dollars and piled up along the western battlefront, would make a wall 475 miles long, 2 feet thick, and 6 feet 8 inches high. The United States alone spent as much money as it did on all the expenses of the government from 1791 to 1914. Over 65,000,000 men were mobilized for the armies and navies, more than 8,000,000 lost their lives, and more than 21,000,000 were wounded. Guns, munitions, and other supplies were used up in quantities undreamed of in previous wars. To support the vast armies, unnumbered men, women, and children were called upon to "do their bit."

How the War Started

The war began as a conflict between Austria-Hungary and Serbia. On June 28, 1914, the Archduke Francis Ferdinand, heir to the throne of Austria-Hungary, and his wife were murdered at Sarajevo, the capital of the rebellious Austrian province of Bosnia. The crime was committed by Gavrilo Princip, one of a group of young men who had planned together to carry it out. Princip was a Bosnian Slav, and so a subject of Austria-Hungary, but the plans had been made in Belgrade, the capital of Serbia; the weapons had come from the Serbian government arsenals; and a number of officers and officials of the Serbian government were involved in the plot. For years the relations between Austria-Hungary and Serbia had been unfriendly. There were many reasons for this, but by far the most important was that many of the people of Austria-Hungary, especially of the provinces of Bosnia and Herzegovina, were of the same race as the people of Serbia and wanted to join that country, and many Serbian patriots looked forward eagerly to the day when they could unite all Serbs, and even all

Yugoslavs (Southern Slavs), into one great state. Under these circumstances, Austria-Hungary did all in its power to suppress the ambitions of its Yugoslav subjects and to prevent Serbia from becoming strong enough to take them away by force. (*See* Bosnia and Herzegovina; Serbia.)

The Austrian government now decided to take advantage of the indignation aroused by the assassination of the Archduke and to settle its quarrel with Serbia. On July 23, the Austrian minister at Belgrade presented an ultimatum to the Serbian government, demanding that Serbia put an end to all anti-Austrian agitation within its borders, that Austro-Hungarian officials be allowed to take part in repressing such movements, and that the Serbian government dismiss from service any civil and military officers who might be designated by Austria. The demands were so severe that they give reason to believe Austria did not expect a satisfactory reply. Only 48 hours were allowed for an answer. Serbia accepted most of the Austrian demands and suggested that the others be referred to the Hague Tribunal or the great powers. Without further discussion, the Austrian minister left Belgrade and on July 28, one month after the assassination at Sarajevo, Austria-Hungary declared war.

All the European Powers Involved

This immediately set in motion the complicated system of alliances, treaties, and promises which the rival nations had been creating for years against just such an event—and within a week, all Europe was at war. To understand this swift result, it is necessary to examine the international situation at the time. Each of the states entering the war hoped that the final peace would solve its international problems and its international rivalries. For a long time statesmen and the people had awaited—with dread but at the same time with hope—the "inevitable" war which alone could solve many of these problems. Serbia, which had in the years before 1914, fought and won against Turkey and Bulgaria, had doubled its territory and saw in Austria-Hungary the last obstacle to Yugoslav unity. Austria-Hungary, with millions of dissatisfied subjects, was determined to maintain its position as a great power, and took the chance of complete destruction rather than submit to the risk of piecemeal disintegration. Russia's interest in the Balkans combined two main elements: the desire to control Constantinople and the straits from the Black Sea to the Aegean, and sympathy for the people of Slavic race and Greek Orthodox religion. Russia had been unable to give Serbian interests effective support in 1908 when Austria had changed the occupation of Bosnia and Herzegovina to annexation; in 1914, she felt that she could and must protect Serbia. In the opinion of many Russians, only the backing of Germany enabled Austria-Hungary to survive and it was Germany that blocked Russia in Turkey.

In the west, France and Germany were divided by the question of Alsace-Lorraine (*see* Alsace-Lorraine) and the enmity born of many wars. France alone could not risk a war with Germany, but Germany feared that in case of war with some other power, France would take the opportunity offered for another round in the age-old struggle for the Rhine. Of these international rivalries, the most recent was that of Great Britain and Germany. Until after the beginning of the 20th century, these two powers had been in general on peaceable and friendly terms. By then commercial competition had begun to weaken this friendship; and when Germany began systematically and persistently to build a great navy, England became suspicious and gradually hostile. In Germany, England was looked on as the chief obstacle to Germany's colonial ambitions and as the prime mover in what Germans regarded as the "encirclement" of their country. Minor causes of friction and misunderstanding multiplied until, in the opinion of some observers, the Anglo-German rivalry was the dominant factor in the international situation.

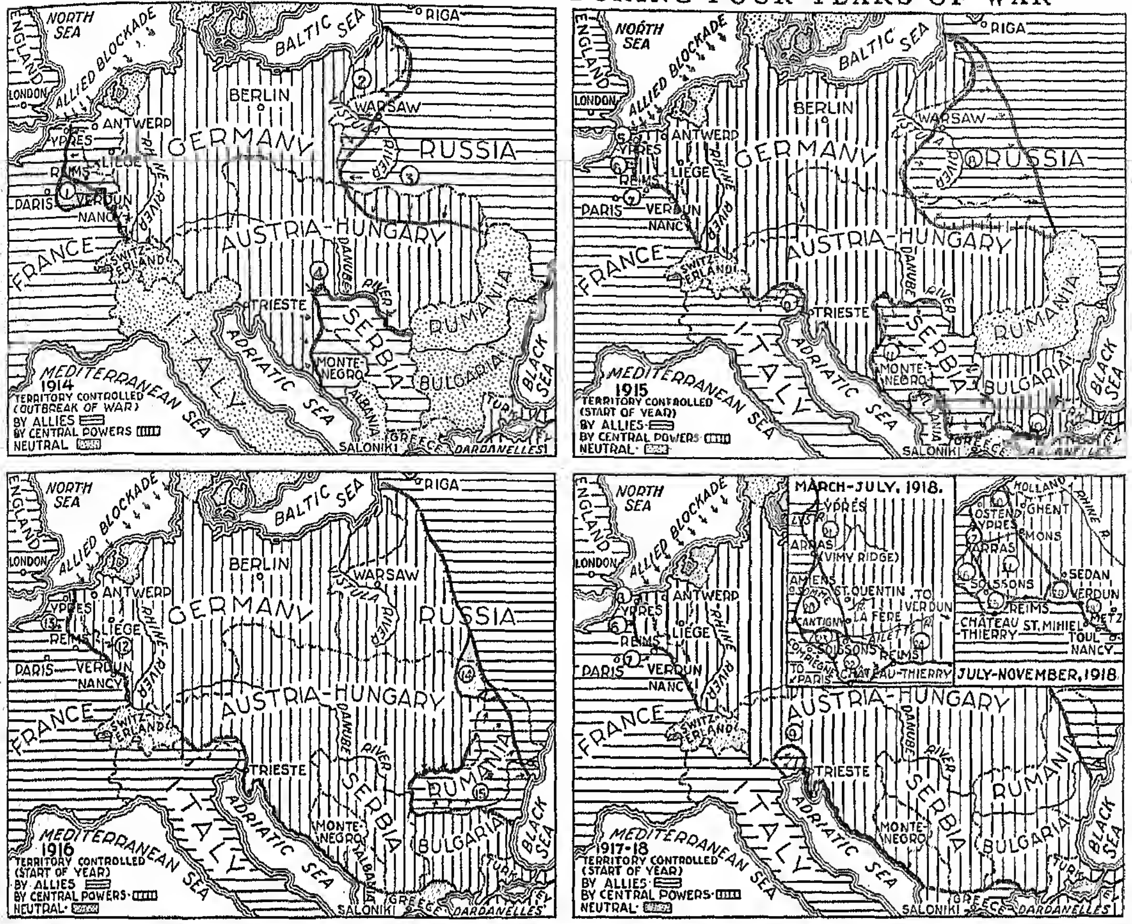
Years of diplomatic struggles with these problems had resulted in Europe becoming divided into two parties: the Central Powers—Germany and Austria-Hungary, with their doubtful ally, Italy, constituting the Triple Alliance; and the Triple Entente Powers, later called "the Allies"—Russia, France, and England. The Balkan states could be expected to take sides—Serbia with the Allies, and Serbia's enemies with the Central Powers. This complicated structure of alliances was brought into action July 28 by Austria's declaration of war, with Russia and Germany taking the chief rôles in the drama.

The Fateful Russian Mobilization

Even before learning of Austria's action, Russia had let it be known that she would not stand by and see Serbia crushed. Since 1879 Germany had been bound to help Austria-Hungary if attacked by Russia; and Germany immediately answered that if Russia offered armed intervention, she would support her ally. She suggested to France and England that they hold their ally Russia in check, but failed to put vigor in her representations made to Austria in compliance with the counter suggestion that she restrain her ally. Then the situation was made more explosive by Russia's announcement (July 28) of partial mobilization, followed by an order for general mobilization given July 30.

This order, added to the existing situation, made war practically inevitable. Relations between Germany and Russia had been tense for some time. Russia, with her huge population, was able to put into the field almost as many troops as Germany and Austria together. France, her ally, was ready with over a million more. The Russian army, however, was slow and unwieldy, while the German army was prepared for rapid, efficient mobilization and action. In view of this, the German military authorities argued that it would be folly to wait for lengthy diplomatic negotiations, thus giving Russia time to get her unwieldy military machine in motion. They insisted that it be peace or war immediately, so that, if it were

THE SWAYING BATTLE LINES DURING FOUR YEARS OF WAR



Strategically considered, the World War was fought on three fronts—on land, at sea, and on the "home fronts," the last being the struggle by each nation to maintain morale and obtain the supplies and munitions needed for its side, and to cripple its enemy's efforts to do the same. *No map can show this, and the war at sea,* consisting of a world-wide suppression of Austro-German maritime commerce, can only be indicated. The blockade was not actually maintained by a line of vessels off the coast, but by armed ships patrolling all the seas, with the British Grand Fleet ready to crush any attempt by the German navy to interfere. The land fighting, however, favored the Germans for three years. In 1914 (*upper left-hand map*) they carried the fighting into France, losing only the dotted area (1) yielded after the battle of the Marne. In the east, they pushed into Poland (2), while the Russians overran Galicia (3). The Serbian front (4) saw only local actions. During 1915 (upper right-hand map) the Germans defended themselves in the west against attacks at Neuve-Chapelle (5), in Artois (6), and in Champagne (7), while their main force overwhelmed the Russians (8). Italy joined the Allies, but accomplished little (9), while the British failed at Gallipoli (10). After the northern fronts were stabilized, Bulgaria joined the Central Powers, and they overran Serbia and Montenegro (11). In 1916 (lower left-hand map), Germany bid for victory at Verdun (12), and the Allies countered on the Somme (13), while Russia attacked in Bukowina (14). Rumania joined the Allies, but was overwhelmed (15). In 1917 (lower right-hand map) the Allies had the preponderance of man power, so Germany merely resisted major attacks at Arras (16), on the Chemin des Dames (17), and at Passchendaele (18), until cessation of northern fighting let her join the Austrians in routing the Italians at Caporetto (19). In 1918, Russia's collapse enabled Germany to make her supreme effort in the west (inset maps). Drives against Amiens (20), along the river Lys (21), to the Marne (22), and against Compiègne (23), extended her lines; and she was engaged in a fifth against Reims (24), when the Allies, at last strongly reinforced by Americans, turned the tide by the Aisne-Marne counter attack (25), the second battle of Amiens (26), the Albert offensive (27), the American Saint-Mihiel (28) and Meuse-Argonne operations (29), and a drive through Belgium (30). Additional territory (31) was yielded to avoid being outflanked, and the Germans were standing on the easternmost line shown, with a retreat to the Rhine their only hope, when the Armistice ended the war.

war, they could win the advantage of getting in a crushing first blow upon their slower opponents.

On July 31, therefore, the German ambassador at St. Petersburg (now Leningrad) presented an ultimatum, demanding that, within 12 hours, Russia cease all military measures and inform Germany that this had been done. As no reply was received, orders were issued on August 1 for the mobilization of the German forces, and hostilities began on the German-Russian frontier. At the same time that Germany sent the ultimatum to Russia, the German ambassador at Paris gave the French government 18 hours to reply to the question whether or not France would remain neutral in a war between Russia and Germany. The French government replied that France would act "in accordance with her interests"; and the French forces, too, were mobilized. On August 3, Germany formally declared war on France.

Belgian Neutrality Is Violated

As only a small part of the frontier between France and Germany was geographically adapted for maneuvering troops, and as that part was both too

narrow to accommodate great armies and was also strongly fortified, the German general staff, since about 1905, had planned to send the main attack on France through Belgium. On August 2, the German minister at Brussels received a telegram from Berlin ordering him to open a sealed envelope that had reached him several days earlier and to present the demands contained therein to the Belgian government. These demands, which had been drawn up by the chief of the German general staff on July 26, stated that Germany had reliable information that France intended to advance against Germany through Belgium. To anticipate hostile attack, Germany would be forced to enter Belgium. If no resistance was offered, it would evacuate the country at the end of the war and make good all damage caused by German troops. In case of resistance, however, Germany would treat Belgium as an enemy. The Belgian government refused these demands and appealed to France and Great Britain for support.

In a speech to the Reichstag on Aug. 4, 1914, Bethmann-Hollweg, the German chancellor, frankly admitted the illegality of his country's action:

> Gentlemen, we are now in a position of necessity and necessity knows no law. Our troops have occupied Luxemburg; perhaps they have already entered Belgian territory. Gentlemen, this is in contradiction to the rules of international law. . . . France could wait, but we could not. A French inroad on our flank on the lower Rhine would have been fatal to us. . . . The wrong—I speak openly—the wrong that we now do we will try to make good again as soon as our military end has been reached. When one is threatened as we are, and all is at stake, he can think only of how he can hack his way out.

England Is Drawn In

Until now, England's position had been uncertain; but violation of Belgian neutrality forced her to act. In 1839, after the separation of Belgium from the Netherlands, the five chief European powers (Great Britain, France, Prussia, Russia, Austria), had signed a treaty guaranteeing the independence and neutrality of Belgium. Four of tho guaranteeing powers were now at war; and not only this situation, but other considerations, forced England to take sides. After 1904, Great Britain had drawn closer to France, and after 1907, to Russia, forming the Triple Entente. For several years the British and French military authorities, with the knowledge and consent of a few of the highest political leaders, had been making plans for a British expedition to the Continent in case the government should decide to join in a war on the side of France. In 1912, the naval authorities had arranged that the mass of the British navy should be concentrated in the North Sea while the French navy should move its strength to the Mediterranean.

Thus, although Great Britain was not bound by a definite treaty of alliance, as were France and Russia, the British government had virtually taken on a moral obligation to support France against Germany. On August 2, Sir Edward Grey, the British secretary of state for foreign affairs, informed the French ambassador at London that if the German fleet came into the English Channel or through the North Sea to undertake hostile operations against the French coasts or shipping, the British fleet would give France all the assistance in its power. The British cabinet and the British public were still divided as to whether or not they should aid France. The news of the German ultimatum to Belgium practically ended this division. Through the British ambassador at Berlin, Sir Edward Goschen, an ultimatum was sent to Germany calling upon her to respect Belgian neutrality. Goschen reported:

> I found the Chancellor very agitated. His Excellency at once began a harangue that lasted for about 20 minutes. He said that the step taken by His Majesty's Government was terrible to a degree; just for a word—"neutrality," a word which in war time had so often been disregarded—just for *a scrap of paper*, Great Britain was going to make war on a kindred nation who desired nothing better than to be friends with her. . . . .

But no satisfactory reply was received and at midnight, August 4, Great Britain was at war with Germany. The rest of the British Empire responded loyally to the call for aid and prepared to send troops.

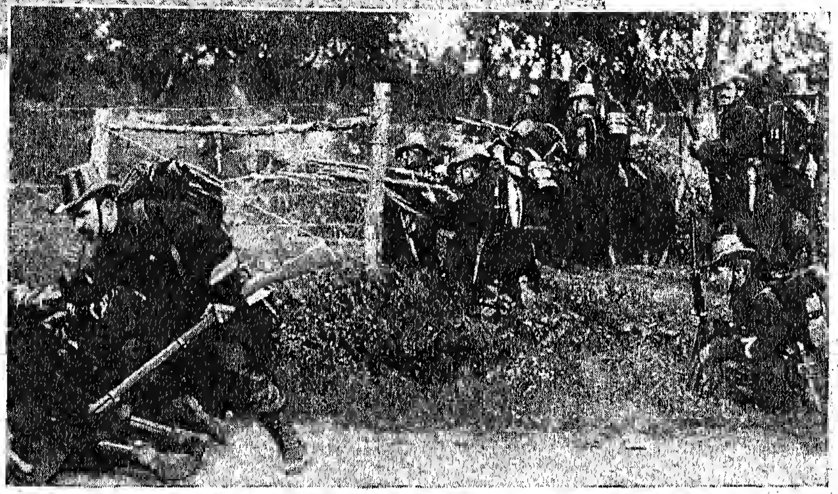
Italy Remains Neutral

The one power concerned which did not leap into the fray immediately was Italy. In 1882, Italy had joined Germany and Austria-Hungary in the Triple Alliance, because her anger at the French occupation of Tunisia overbalanced her traditional enmity to Austria. But by 1900, anti-French feeling had subsided, and the two powers had compromised their Mediterranean colonial rivalries, Italy agreeing not to oppose the French in Morocco, and France recognizing Italy's interest in Tripolitania. In 1902, they had agreed that if either were attacked or found itself compelled to declare war in defense of honor or security, the other would maintain strict neutrality. In terms of practical politics, that really meant that except in case of an unprovoked attack by France on Germany, Italy probably would not support Germany. In 1909, Italy and Russia reached an understanding in opposition to Austrian policy in the Balkans.

It had been expressly understood from the beginning of the Triple Alliance that Italy, which had a long coast line exposed to naval attack, was not obliged to take part in a war against England. Italy renewed her signature to the Triple Alliance in 1912, but in 1914, the Italian government announced its neutrality on the ground that the circumstances which had brought on the war put her under no obligation to fight on the side of her allies. This freed France from the necessity of maintaining a strong force on her Italian frontier and so contributed to the later Allied success at the Marne.

In general, Italian public opinion approved the action of the government in not siding with Austria-Hungary, and many Italians favored joining the Allies to secure *Italia irredenta*—the territories in Austria-Hungary inhabited by people of Italian nationality. The Italian government now saw an opportunity to obtain some of these territories by agreement with

BELGIUM'S BRAVE BUT FUTILE RESISTANCE TO INVASION



When the German *feldgrau* (field gray) tidal wave of troops rolled over the Belgian border, the hopelessly outnumbered Belgians nevertheless fought. At the top a field-gun battery is firing in the streets of Hofstade, while an unconcerned pig wanders about, apparently *not* having heard that war has been declared. The lower picture shows members of the Belgian carbineers trying to stop German cavalry. But the German army could not be stopped.

Austria, as the price of her neutrality, and at the same time began to bargain with the Allies. This bargaining lasted through the opening months of the war, and the following winter.

The Question of War Guilt

During and for some time after the end of the war, it was generally asserted in most parts of the world that Germany had been primarily responsible for bringing on the catastrophe. In the treaty of peace, Germany was forced to accept the full responsibility for bringing on the war. Calmer reflection and fuller knowledge of the details of European history before the war and during the frantic weeks in July 1914, when it began, have led to a gradual modification of opinion. Students still differ in their interpretation of many facts; but they are completely agreed that responsibility for the war must be divided.

Europe in 1914 was in such a situation that any one of the international rivalries described might have produced a war. It merely happened to be the Near Eastern question which provided the cause. Probably none of the responsible leaders in any country wanted a European war, but none of them was capable of averting it. The mutual rivalries of the powers had created an atmosphere of suspicion and fear that made it impossible to discuss coolly and reasonably the questions at issue. In every country, the military authorities pressed for immediate action, fearful that their opponents might obtain the advantage of getting in the first blow; and every country contributed to produce the situation which resulted in war.

Germany cannot escape the responsibility for her support of Austria-Hungary in July 1914, for her declarations of war on Russia and France, and above all for her illegal attack on Belgium. If Austria had been willing to consider the Serbian reply as a basis for further negotiations; if the weak Czar had not yielded to the demands of the Russian militarists for general mobilization; if France or Great Britain had brought pressure to bear on their Russian ally to prevent this hasty action, the outbreak of hostilities might possibly have been postponed, and once postponed, might perhaps have been averted. All of the powers, then, must bear part of the responsibility, whether for their actions or for their omissions.

Strategy of the German Offensive

In making plans for a war against France and Russia, the German general staff faced the fact that the combined armies of those two powers were larger than the combined German and Austrian forces. They decided, therefore, that they could more easily obtain victory by crushing the better prepared enemy, France, and then turning against Russia. The plan of operations according to which the Germans acted in 1914 was based on one completed in 1905 by General von Schlieffen (chief of the general staff from 1891 to 1905). Schlieffen's plan was to leave a small force to face the Russians in eastern Germany and to use the mass of the German army against France. Of the troops on the western front, about one-seventh were to occupy the line from the Swiss frontier to the great fortress of Metz in German Lorraine, to engage as many French troops as possible and to retire slowly if

pressed hard. Six-sevenths of the available divisions were to carry out a great swinging movement, the left flank pivoting on Metz, the right sweeping through Belgium into northern France, to drive the French army before it and to crush it in the narrowing space between the Germans and the eastern frontier.

Schlieffen's successor as chief of the general staff, General von Moltke (the mediocre nephew of the great field marshal of Bismarck's time), retained the substance of this plan but modified it in details. Schlieffen had emphasized the importance of the strong right wing; his dying words are said to have been: "Make the right wing strong." But when an increase in the strength of the German army put additional divisions at the disposal of Moltke, he put them not on the right wing but on the left. In other details, too, he diverged from Schlieffen's conception.

To open the way into Belgium, Moltke planned that, as soon as war was declared, the German troops nearest the frontier should attempt to pass between the forts of the Belgian fortress of Liége in order to seize the town and prevent the destruction of the bridges over the Meuse River. In the meantime, heavy artillery fire would put the forts out of action. The first German attempt to reach Liége was checked by the Belgians on August 5, but during the next day a small body of troops, led by General Ludendorff in person, worked its way past the forts into the city. The forts resisted a little longer, but by the time the German mobilization was completed, great 42-centimeter howitzers had battered them to pieces. The delay had little effect on the course of the campaign. The Germans entered Brussels on August 20, shut up a large part of the Belgian army in the fortress of Antwerp, and moved on into France.

The French Defense on the Marne

The French army of about 4,000,000 was practically equal in numbers to the German, but only 1,500,000 of these were fully trained first-line troops. The plan of the French general staff was to mobilize the mass of the French army along the frontier from Switzerland to and including southeastern Belgium. The French were not surprised by the fact that the Germans came through Belgium; what they did not expect was that the Germans would swing so far to the north, or that they would use their reserves as first-line troops, and thus gain an added advantage in effective man power.

To meet the German attack, the French planned a counter offensive: a minor attack in southern Alsace for the moral effect of occupying part of the "lost province," and a main stroke at the center of the German army in Lorraine. The former was at first successful, and for a short time French troops stood on the Rhine, but the main attack through Lorraine was checked.

As General Joffre began to realize the real menace of the German plan, he started a hasty change in the location of his troops. Several French armies and the British Expeditionary Force, under General French, which had landed in France, advanced to meet the Germans at the Belgian frontier. But the French were driven back at Charleroi, and the British at Mons (August 23) and forced into a rapid southerly retreat. In the meantime the German left wing, which Moltke had made stronger than Schlieffen had intended, became impatient and unwilling to retire gradually before the French and to leave the glories of victory to the troops on the right. Permission was obtained to attack. Now, however, the French troops, which should have been held by the German left wing, retired behind the fortified line, reorganized, and many of them moved to the north.

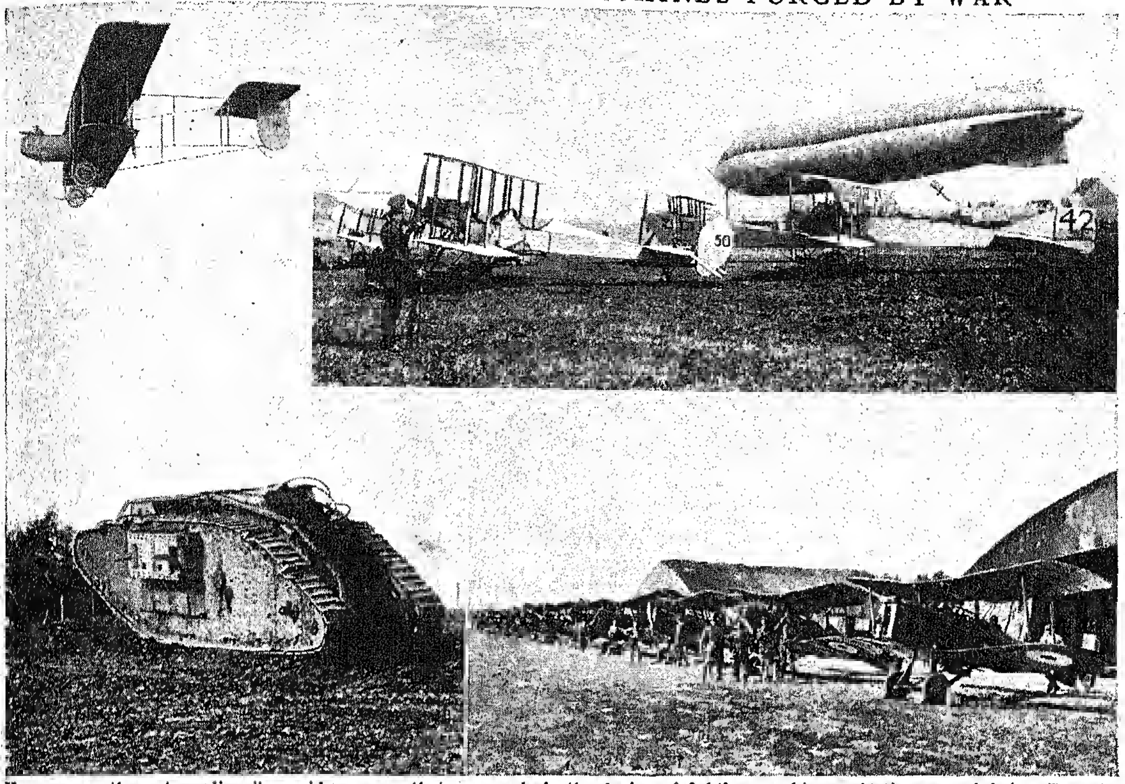
At the beginning of September, the German army on the extreme right was moving past Paris. Strenuous fighting, hard marches, and the natural difficulties of a campaign had led to some disorder in the German sweep. Headquarters were in Luxemburg, about 150 miles from von Kluck's army which formed the right flank. Both because of the general staff's inability to coördinate the movements of the armies, and because it detached troops for use against Russia, von Kluck now found himself without men enough to maintain contact with the army on his left and also envelop Paris. Consequently, when almost in position to strike Paris, he turned southeast to close the gap in the German front, thus virtually turning his back on the French capital.

General Gallieni, the military governor of Paris, saw the opportunity thus presented. He persuaded Joffre to let him use the newly formed Sixth Army to attack the exposed flank of the German army and to order an attack along the whole front. From the 6th to the 9th of September was fought the first battle of the Marne (*see* Marne River). The Germans retreated to the line of the Aisne and Vesle rivers. Thus their plan to crush the French army had gone awry, and their hopes for winning a quick victory in the war were blasted.

Stabilizing the Western Front

After a battle on the Aisne (*see* Aisne River), in which neither side could gain a decided advantage, the Allied and German armies tried to outflank each other. The result was the "race to the sea" which ended in a continuous battle line from the Swiss frontier to the North Sea. The Germans succeeded in extending their lines to the west of Ostend and Zeebrugge and also in taking Antwerp from the Belgians, in spite of British aid, on Oct. 9, 1914. This left to the little Belgian army only a few square miles of land in the extreme western corner of the country; there the Belgians successfully defended themselves until the end of the war, cutting the dikes and letting the water flow over the lowlands when other defenses failed. In the series of struggles (October 10–November 11) known as the first battle of Ypres (which the British "Tommies" insisted upon calling "Wipers"), the British beat off a powerful German drive to seize the Channel ports (*see* Ypres). Winter then put an end to operations on the western front, with the armies

AMAZING DEVELOPMENT IN MACHINES FORCED BY WAR



Here we see the extraordinarily rapid progress that was made in the design of fighting machines. At the upper left is a Farman biplane, which was considered a good airplane in 1914. It was a pioneer air fighter, having been equipped with a machine gun. Beside it is a 1914 British airdrome, with crude machines and a small "blimp," or dirigible. Contrast them with the sleek, powerful airplanes used in 1918 (lower right). At the lower left is that marvelous product of the war, a "tank," really a small motorized fort, able to break through barbed wire, cross trenches, and overwhelm enemy infantry with machine-gun fire.

deadlocked in the trench warfare which was to last four years, without either side breaking through.

German Successes Against Russia

This stalemate in the west was somewhat offset for the Germans by their brilliant success in the east. The Russian mobilization under the Grand Duke Nicholas had been surprisingly rapid. The left wing of his huge force swept the Austrians almost out of Galicia by the end of September (leaving only the fortress of Przemysl holding out for several months), and the right wing sent two armies against east Prussia—one under Rennenkampf from the east, and one under Samsanof moving north from Poland. The frightened German commander in east Prussia, after a defeat at Gumbinnen August 19–20, was hurriedly replaced by Hindenburg, with Ludendorff as chief of staff, and these two, using plans already prepared by Colonel Hoffman of the staff, staged an amazing reversal of fortune. First an encircling movement, based on the village of Tannenberg, surrounded Samsanof's army, forcing its surrender August 31. The Germans then wheeled back against Rennenkampf, struggling through the Masurian Lake region, inflicted a terrific defeat (September 5–9), and forced the Russians to flee. Aside from heavy fighting to stabilize the front before Warsaw, this ended the 1914 campaign in the east, with the armies deadlocked as in the west. But the open nature of the country and its vast distances made it impossible for either army to dig in and defy assault; so the war could be, and was, forced into the open again in the following spring.

Events in Distant Lands

Aside from the main struggle, the most momentous event of 1914 in its direct effects, was Turkey's decision to join the Central Powers; it began hostilities October 29. This cut off Russia's easy sea communication with her allies—through the Dardanelles and the Mediterranean—a heavy blow, since Russia lacked the ability to supply herself with anything like the war munitions she needed. Furthermore, it threatened England's communications with the Orient through the Suez Canal, and compelled the Allies to use large forces throughout the war to prevent this disaster. Finally, it encouraged the Germans mightily, by making them believe that their great dream of a central European-Asiatic *bloc* ("Berlin-to-Bagdad") could be realized.

Japan cast her lot with the Allies, and declared war against Germany August 23. In direct effort, however, she contented herself with the siege and capture of the German Far Eastern stronghold at Tsingtau (August 27–November 7). British colonials in South Africa

WHERE "EASTERN FRONT" BATTLES WERE FOUGHT

This map shows the area in which the war was fought out between Germany, Austria-Hungary, Turkey, Russia, and the Balkan states—also the rivers, mountains, and the Black Sea-Mediterranean straits, which affected strategy in the East.

also organized efforts to oust their German neighbors, but had not accomplished much by the end of the year.

Novel Methods of Warfare

During the winter of 1914–15, every nation concerned struggled with the tremendous problems created by war on such a scale. "All former experience in war may as well be thrown on the scrap heap," declared the French general, Joffre, soon after the war began. For one thing, this was not a war of armies and navies, but of fighting nations. A single battle consumed artillery ammunition enough to fight an entire war of earlier days; all the railroads of northern France were scarcely able to keep the troops supplied. Since the universal service system had placed practically every able-bodied man in Continental Europe in the armies or navies, finding workers for the factories and transport systems promised to be a terrific problem. All this meant that civilian activities would have to be sharply curtailed, and the civilian population organized almost like an army—"every man, woman, and child in the right place."

The weapons exceeded anything ever devised before. Airplanes and submarines came into extensive use for the first time (*see* Airplane; Submarine). Huge guns—some of them throwing shells 70 miles—appeared, while field guns were used by the scores of thousands (*see* Artillery). Machine guns and extensive trenches, with barbed-wire entanglements, made infantry attack almost hopeless, unless the assailed position had been almost obliterated by artillery fire. Trench mortars, hand and rifle grenades, and steel helmets came into general use. Science provided delicate instruments for "listening in" on the enemy's telephone conversations over lines in the opposing trenches; radio was largely used. Later in the war "tanks"—giant armored tractors carrying machine guns and small cannon—lumbered into action, defying enemy bullets, smashing wire entanglements, crossing trenches, destroying machine-gun nests, and doing much to win the war for the Allies (*see* Tanks).

The Question of Gas Warfare

The German use of gas at the second battle of Ypres in April 1915 aroused special resentment. One of the Hague conventions (which all of the powers at this time in the war had accepted) prohibited the use of projectiles designed to spread asphyxiating gases. Technically, the release of chlorine gas from cylinders was not a violation of this law, but the Allies said it was contrary to the rule against the use of weapons or material calculated to cause unnecessary suffering. However that might be, both sides soon devised masks which offered effective protection against most kinds of gas, and both sides were soon using gases and gas-filled shells freely. (*See* Gas Warfare.)

Millions of men were living and dying under conditions which mankind had never before faced. It is no wonder that these conditions bred violations of the rules of warfare by both sides. These were due, however, not to organized effort, but usually to the moral collapse of an individual, to the hysteria of the mob, or often to the sheer impossibility of obeying all the old rules. Many charges of "German atrocities" are now known to have been invented or exaggerated by Allied propagandists. Many such actions were incidental to the normal operations of war on a scale hitherto undreamed. But at the time the accusations aroused great indignation, and the severity with which the Germans applied the laws of war gained them the hostility of most of the world.

Campaigns of 1915

For their 1915 campaign the Allies decided to try to force Germany from her trenches in the west and defeat her, if possible. If they could not gain a vic-

tory, they hoped at least to keep enough German forces occupied so that the Russian "steam roller" could break in over the eastern frontiers. Von Falkenhayn, who had replaced von Moltke as German chief of staff, was convinced that the Allies could not break through the German trenches in the west; so he decided to stand on the defensive there and dispose of Russia.

The Allies were cheered by Italy's decision to enter the war on their side. In April 1915, she signed the secret Treaty of London, which offered her much more Austrian territory than Austria had been willing to cede; and on May 23, she declared war against Austria-Hungary. No declaration against Germany came, however, until August 1916.

The fighting of 1915 did not bring the results that the Allies had hoped for. The French spring attacks in Artois (May 9–June 18) and the British effort at Neuve-Chapelle (March 10) won local successes only, at terrific cost; while a powerful German counterstroke northeast of Ypres caused further trouble. This battle saw the first use of poison gas, on April 22. The gas routed some French colonials, and for a short time the road to the Channel was open, but then the Canadian 1st Division, commanded by General Currie, blocked the passage (*see* Currie, Gen. Sir Arthur). The Canadian division, after three months' training in England, had landed in France on February 11, and moved into the front line just in time to win distinction in this second battle of Ypres (*see* Ypres). In May and June it won further glory at Festubert and Givenchy.

In contrast, the German effort against Russia was brilliantly successful. Early in 1915 the Russians had poured up the Carpathians and through the passes into Hungary itself. Waiting until the Russians were well involved, the Germans under von Mackensen on May 2 broke through the center of the long line on the Dunajec River, and in two months of fighting (centering around Brest-Litovsk after July 15), drove the Russians out of Poland as far east as Pinsk, beyond the Pripet marshes, inflicting tremendous casualties and taking 750,000 prisoners.

The French meanwhile had recovered, and on September 25 attacked in Champagne. The Germans, however, kept the French from more than local gains; then, when the situation was safe, turned south and in concert with Austria and Bulgaria, which declared war October 11, overran Serbia and Montenegro.

This won a clear road through to Turkey, which meanwhile had been holding out successfully against bungling Allied attacks, commencing with an attempt (February 19–March 18) by second-class warships to force the Dardanelles. The only result was to warn the Turks, and they were ready when on April 25 Sir Ian Hamilton landed a force of "Anzacs" (Australia-New Zealand Army Corps) on the narrow Gallipoli peninsula, for a combined land-and-sea drive upon Constantinople. The Gallipoli expedition proved to be a costly failure, and in January 1916 the troops were withdrawn.

A British expedition under Sir Charles Townshend which had advanced up the Tigris River from the Persian Gulf, also met disaster and was forced to surrender to a vastly superior force of Turks (April 29, 1916) at Kut-al-Amara. In the region of the Caucasus Mountains, however, the Russians captured the important city of Trebizond on the Black Sea, and cleared Armenia of the Turks.

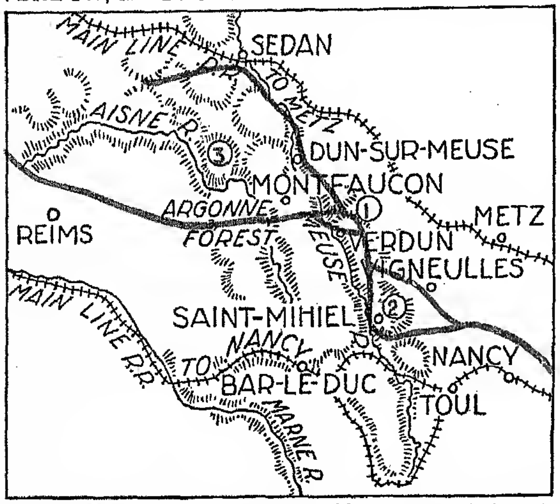
The War at Sea

While the attention of the world was focused on these titanic struggles on land, even more decisive, though much less spectacular, events were taking place at sea. No sooner had German wireless flashed the

LUCKLESS RUSSIANS WHO BATTLED VAINLY AGAINST GERMANY

These are typical of the armed "muzhiks," flung by the million under incompetent generals and with poor equipment, against Germany's skilfully led and superbly equipped armies. Appalling losses resulted, doing much to cause the Revolution of 1917.

VERDUN, A "STORM CENTER" IN THE WEST



This is the troubled area along the Meuse, west of the old Franco-German border, which saw much of the heaviest fighting of the war. In the center (1) is Verdun, scene of the terrific 1916 German attack, and below (2) is the Saint-Mihiel salient, won by the Germans in 1914, and retaken by the Americans in 1918. Above Verdun is the region (3) of the Meuse-Argonne battle, and at the top its objective, the railway through Sedan.

news of war than German merchant vessels everywhere sought safety in home or neutral ports, according to prearranged plans. The German fleet, knowing itself too weak to meet the British navy, also retired to safe waters behind the German island fortress of Helgoland and at the mouth of the Kiel Canal, where it remained securely "bottled up." Within a few days Germany's vessels and trade were practically swept from all oceans, except the Baltic, which the Germans controlled throughout the war. To be sure, a few commerce raiders such as the *Emden* led a spectacular career in the East Indies for several months before they were captured or destroyed; three British cruisers were sunk in September by submarines in the North Sea; and a German squadron led by Admiral von Spee defeated a smaller British squadron off Coronel, Chile, Nov. 1, 1914. Admiral Cradock, the British commander, went down with his ship. But that German squadron was destroyed by the British under Admiral Sturdee, near the Falkland Islands, Dec. 8, 1914; only one German ship, the *Dresden*, escaped. A few weeks later, Jan. 24, 1915, the British battle cruisers, commanded by Vice-Admiral Beatty, fought the running battle of the Dogger Bank with a slightly weaker German squadron, which succeeded in escaping to the protection of the high-seas fleet after losing the battle cruiser *Blücher.*

The Battle of Jutland

The German fleet itself did not challenge the Allied control of the oceans until the battle of Jutland, May 31, 1916. This was the most important naval conflict of the war. The British cruiser fleet encountered the German high-seas fleet off the Danish coast in the late afternoon. The mists were heavy, and by the time the British dreadnought fleet arrived on the scene, oncoming night made it difficult for the fleets to maneuver. The British fleet comprised 37 capital ships and 114 others; the Germans had 27 capital ships and 74 others. The British, commanded by Admiral Jellicoe, suffered heavier losses in ships and men, but Admiral Scheer withdrew the German fleet during the night, leaving the British with a costly victory.

Thus throughout the war the British held undisputed control of the surface of the sea, and maintained unbroken the blockade which many students believe did as much as all the armies to win the war. Lacking many important raw materials, such as rubber, cotton, and copper, and sufficient foodstuffs, particularly fats, Germany was doomed to slow but certain exhaustion, if she could be kept cut off from overseas supplies. Direct importation the British navy could, of course, and did, prevent. The one difficulty was that the neutral countries, Holland, Denmark, Norway, and Sweden, adjoining Germany could, unless prevented, import what Germany needed and resell to her. England met this situation by "rationing" the neutrals; that is, allowing them to import only as much as they themselves needed, so there would be no surplus for resale to Germany. Protests that this violated international law were met with the promise to settle damages later.

Germany's Submarine Campaign

One grim menace, however, threatened British maritime security. England could not exist more than a few months without imported food and supplies, so the Germans decided that while England was trying to starve them by blocking the surface of the sea, they would try to starve the English by submarine operations beneath the surface. This they could do provided they had enough submarines, could use them effectively enough, and—most important of all—if they were willing to violate existing international law. This would be necessary because international law provided that unresisting enemy merchant vessels were not to be sunk unless reasonable safety was provided for the crews, and that neutrals were not to be molested unless carrying contraband (materials directly useful in fighting). But a submarine, being highly vulnerable to ramming and gunfire from even small cannon, would risk destruction if it warned a vessel before torpedoing it; and lack of space prevented taking captured crews aboard. Neutral ships presented to Germany much the same problem the neutral countries did to England, and Germany foresaw that to make the blockade complete, she might later have to operate against all neutrals approaching the shores of England and France.

Admiral von Tirpitz, head of the German navy, finally won the German government to his views that the probable benefit of such a campaign would outweigh the dangers. On Feb. 4, 1915, Germany proclaimed that the waters around Great Britain and Ireland, including the whole of the English Channel, were in the war zone and that after February 18, enemy merchant ships met in this zone would be

WHERE ITALY FOUGHT BOTH NATURE AND THE FOE

Italy set herself to make a direct attack on Austria-Hungary in mountainous country. Above is a patrol clad in white for operating in Alpine snow, and the smaller picture shows the goggles and black grease used to guard eyes and skin against the glare of snow-reflected sunlight.

destroyed. Neutral ships, "in view of the misuse of neutral flags . . . and owing to the hazards of naval warfare" might also be endangered.

The first stages of the submarine campaign did not, however, produce material results comparable to the moral loss to Germany produced by such incidents as the torpedoing of a great passenger liner, the *Lusitania*, off Kinsale Head, Ireland (May 7, 1915), with the loss of 1,198 lives—men, women, and children, of whom 124 were Americans. More and larger submarines gradually made the campaign more effective, and by April 1917, when the United States entered the war, more than 3,000,000 tons of British shipping—16 per cent of her total 1914 merchant fleet—had been sunk, and as Admiral Jellicoe told the American naval commander, Admiral Sims, continuation of the losses would force England out of the war.

Military Events of 1916

After the disappointing results of 1915, the British government was reorganized on a coalition basis, with Asquith still premier but with Lloyd George assuming increasing importance (*see* Lloyd George, David). The British army was increased to 5,000,000 men, first by voluntary enlistment under Lord Derby's plan of national registration for reconciling the needs of war industries with the demands of the army; and then after January 1916, by conscription (*see* Kitchener of Khartum, Earl). By the end of 1915 there were 36 British divisions in France. Steps were also taken both in France and Great Britain to speed up the production of war material, so that in "the great push," as they called the intended offensive of 1916, there should be plenty of supplies available.

During 1915, Germany and Austria perhaps had dreaded most the possibility that Italy might bring decisive power to bear. But the Italians had chosen to deliver a frontal assault on Austria along the frontier; and the Austrians, aided by the mountainous terrain, had held their own except for trifling Italian gains, without having had to withdraw from the fight against Russia. With the Italians immobilized by their own choice of front, and Russia crippled, Falkenhayn felt that now the time had come to deliver the decisive blow against the French and British. For the effort, he chose the great salient in the French line at Verdun; and he proposed to break through, or, failing that, to keep drawing French reinforcements into the sector and there destroy them until her losses should compel France to sue for peace.

On February 21, under the command of the German Crown Prince, the attack came, preceded by an artillery bombardment more intense than any before known in war. For a short time the Germans swept everything before them; but as Verdun was about to fall, the defense, hastily reorganized by General Pétain, checked the advance. Many now urged Joffre to abandon the town and retire behind the Meuse. But Joffre knew that Falkenhayn would try to wear down his army, wherever it stood; so he forbade retreat, and for months the bitter struggle went on, without much change of situation (*see* Verdun).

On July 1, after a week's bombardment, the British came to the aid of France with their long-prepared Somme offensive. By the use of cannon in numbers heretofore unknown they gradually moved forward, and when winter ended the fighting they had driven a wedge of considerable size to a depth of nine miles into the German line. But this success was won at the cost of terrible losses, amounting to about 800,000 men (*see* Somme River).

During the summer the Italians had succeeded in crossing the Isonzo River and capturing Gorizia (August 9). But the gain was not worth their losses and their success did not affect the general situation. Far more important was the Russian offensive in Galicia

and Bukowina. Starting June 4, Brusilof drove the surprised Austrians into rout, and captured 300,000 men. Germany now had to support Austria, and stand on the defensive on the western front. Brusilof's success also encouraged Rumania to join the Allies, her declaration of war coming August 27.

Rumania, however, was soon disposed of. As soon as cold weather stopped active fighting further north, Bulgaria, Austria, and Germany organized an attack under von Mackensen which swept the Rumanian army into the eastern end of the country, leaving Rumania's riches of oil and grain in the hands of the Central Powers. Aside from Gorizia, the only Allied success for the year was the start, December 12, of a British attack under General Maude against the Turks in Mesopotamia—an attack which drove through to the capture of Bagdad March 11, 1917.

HOW TRENCHES LOOKED FROM THE AIR

These German trenches were near Montsec, in the Saint-Mihiel salient, and faced to the right. Note the "bays," or dents in the line, to limit the effect of shell fire, and the shell holes where the Allies harassed the trench connecting these defenses with the woods. The wavy white lines are paths.

The Halfway Point of the War

In many ways the winter of 1916–17 saw the end of the first phase of the war and the beginning of the second and final phase. For one thing, there was a wholesale change of leaders. Sir Douglas Haig had already (December 1915) replaced Sir John French as British commander-in-chief, and Lloyd George became premier of England. The French now replaced Joffre with Nivelle, and von Falkenhayn gave way to von Hindenburg for the Germans.

Far more important, however, were signs of collapse on the part of one great combatant, Russia, and of the entry of another, the United States. During the first two and one-half years of the war, the Russian army suffered many defeats because it was poorly equipped with arms and supplies. Russia's soldiers had entered the conflict enthusiastically and fought bravely. But they had lost heavily against the array of machine guns and the vast batteries of light and heavy artillery of the Germans. In fact, no other nation in the war suffered losses comparable to those of Russia. This was rightly blamed upon the incompetent and corrupt officials surrounding the Czar.

The Russian Collapse

On March 11, 1917, a revolution broke out in Petrograd (the name which had been given to the former St. Petersburg). Four days later the Czar abdicated. The new republican government under the moderate Socialist, Kerensky, decided to prosecute the war vigorously (*see* Russia). But the people were sick of the war; and groups of workmen and soldiers established councils (*soviets*). On November 9 this revolutionary party (the Bolsheviki) overthrew the Kerensky government and at once asked for an armistice. On March 3, 1918, the Bolshevik government signed a separate treaty of peace with the Germans at Brest-Litovsk. By the terms of this peace, the Russians lost Poland and nearly all the territory bordering on the Baltic Sea. They were also required to surrender a great area of land in the Caucasus Mountains to Turkey, and pay a huge war indemnity to Germany.

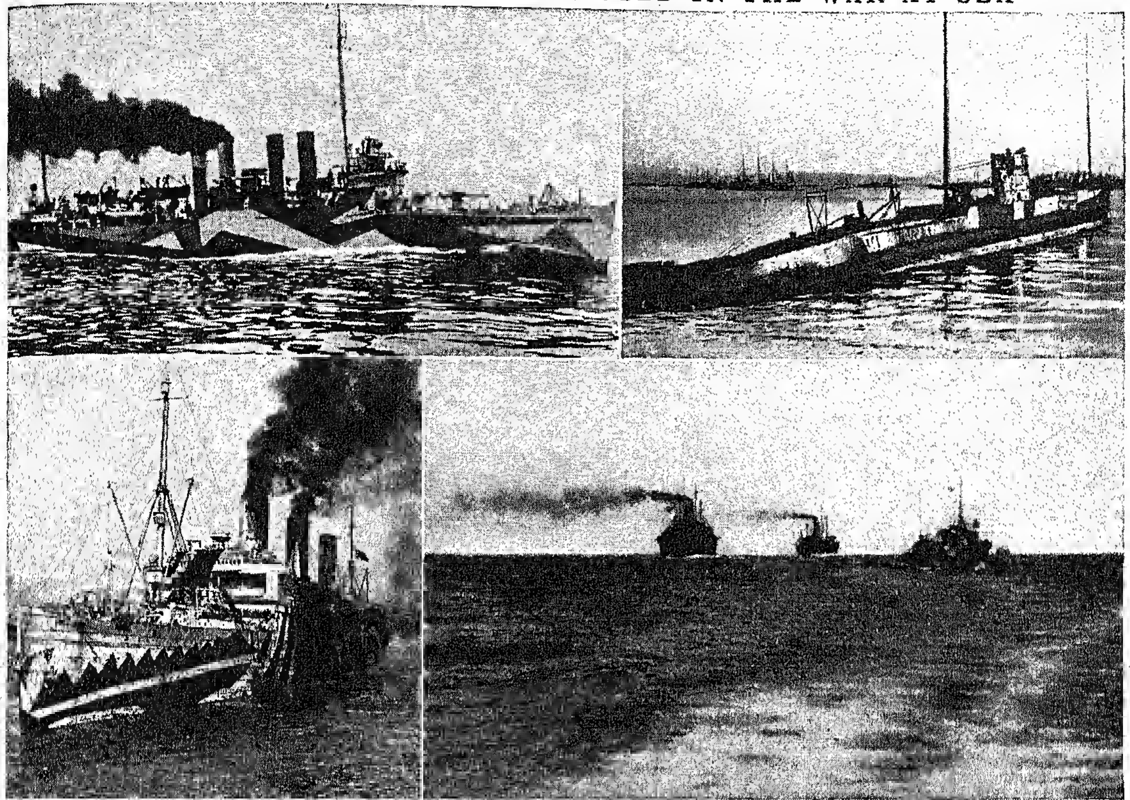
The United States Enters the War

As will be told in greater detail later, American public opinion had been slowly but steadily setting against Germany since 1914. Germany now took a step which resulted in bringing the United States into the war on the side of the Allies. With the knowledge that France and England could muster 3,900,000 men against her 2,500,000, Germany was persuaded that she could not attack. The only remaining way to press the Allies harder was to intensify the submarine campaign. This she did by declaring "unrestricted" submarine warfare in a zone surrounding the Allied coasts. That is, all vessels, neutrals included, were to be sunk without warning if found in this zone. To this violation of international law the United States responded by declaring war April 6, 1917.

The Americans could help immediately with loans, by sending destroyers to help fight the submarines, and by sending battleships to reinforce the British Grand Fleet. But everyone knew it would take a year or more to organize an effective American army, and meanwhile the Allies felt strong enough to attack, encouraged by the fact that a large portion of the German army was in a vulnerable "bulge" between the Somme wedge on the north and the Aisne on the south. But before the fighting started, the Germans escaped this trap by devastating the district and retiring to a new defensive position, called by the Allies the "Hindenburg line."

The Allies nevertheless attacked, and the British took Vimy Ridge on April 9 (*see* Arras). The Canadian corps in the center stormed the ridge, and held the east slope. The general advance continued for five days, and drove forward from four to six miles.

GLIMPSES OF VESSELS MOST USED IN THE WAR AT SEA



At the top are the types of vessel which saw most service on the respective sides—a German submarine (right), and (left), an American destroyer, representative of the vessels which proved best for suppressing submarines. The *Leviathan* (lower left), was America's largest troopship, and to its right, merchant vessels are anxiously voyaging to Europe, led by a destroyer. Note how naval camouflage aimed, not to conceal, but to distort the apparent shape of the vessel and make its course hard to determine ("confusion" camouflage), thus increasing the difficulty of aiming torpedoes at it.

The French attack under General Nivelle opened April 16, with an attempt to capture the Chemin des Dames ridge between Soissons and Reims. The French attack, however, had been delayed for three days, so that the advantage of the British pressure in the north was partly lost. The French made slight local gains, which were not worth the terrific losses, and by May 5 the offensive was definitely halted, with many French regiments practically in mutiny. This battle robbed the French of their offensive power for the rest of the spring and summer.

The British now had to carry the burden of attack while the French were recovering. For this purpose they selected the region in Flanders around Ypres, and commenced operations by capturing the Messines-Wytschaete Ridge (June 7–14), thus removing an awkward salient. The main offensive was launched in Flanders on July 31. As a diversion, to keep the Germans from transferring reserves to Flanders, the British tried several minor operations, one of which was the attack on Hill 70, near Loos, by the 1st and 2d Canadian divisions, on August 15. The Canadians were again conspicuous in the fighting around Passchendaele in October and November, when they fought for weeks in mud and slime to their hips. With very heavy losses, the British, Australians, and Canadians finally drove the Germans from Passchendaele Ridge. As a fitting climax to the series of battles, which are sometimes called the third battle of Ypres, the Canadians took the town of Passchendaele on November 6.

To end the year 1917 the British attacked farther to the south, near Cambrai, on November 20. Here a large force carried out a surprise attack in which tanks were first extensively used. It succeeded at first, but the British were in turn taken by surprise and lost nearly all the ground they had gained. In the meantime the French army had recovered its morale under its new commander, General Pétain. In August it retook the last of the ground lost at Verdun in 1916, and in October it successfully completed the Chemin des Dames operation of the spring. These various victories, however, not only were barren of strategic result, but had so whittled down Allied man power that the Germans, using troops released by the Russian collapse, would have the superiority in 1918.

Italy's Caporetto Disaster

Allied gloom was deepened by a rude shock received in Italy. There, during the summer, the Italians had made steady progress through extremely difficult

country toward their goal, the city of Trieste. But in their zeal to capture this city they left the line of battle on the upper Isonzo River poorly guarded. In this region, late in October 1917, the Austrians and Germans suddenly descended like an avalanche upon the Italian forces at Caporetto. A terrible rout was the result, which undid the work of two years, and cost the Italians about 265,000 prisoners and 2,000 cannon. Only on the line of the Piave River were the Italians able to stop the retreat, and for the next year this remained the battle line.

This battle also was notable for the successful use of propaganda by the Germans. Before the battle, Austrians in the front line had established almost friendly relations with the Italians, and airplanes had distributed friendly statements. The Italian soldiers had been impressed, and their leaders were not awake to the danger. Then suddenly the friendly Austrians were withdrawn, shock troops took their place, and disaster overtook the surprised Italians.

For the Allies, the one cheerful military episode of that gloomy period was the capture of Jerusalem December 9, after a strenuous campaign, by a British and Arab force led by General Allenby.

Germany's Chance for Victory in 1918

It was now clear to all that 1918 might bring victory to the Germans. True, Germany's most formidable bid for victory—her submarine campaign—had been curbed by destroyers and the convoy system of escorting merchant ships in small fleets surrounded by warships. But so much tonnage had been lost that the British did not see how they could spare ships to transport a large American army, even if one could be made ready to come. Moreover, the Germans now had a slight advantage in man power, and the skill to use it to good advantage.

The civilian and army morale of the Central Powers by now was feeling the pinch of the Allied blockade. But Allied morale was equally low. Their losses had been terrific; and while the Germans could draw consolation from many impressive victories, the Allies had only defeats or at most barren victories to show. Another impressive German success—particularly if it crippled military operations by such a blow as the capture of Paris or of the Channel ports—might well cause Allied morale to break, forcing a suit for peace on German terms before American man power could be organized and brought to bear in France.

The Opening Blow on the Somme

When the campaign of 1918 opened, the battle line of the western front ran in a southerly direction from a point on the North Sea near Ostend, past Ypres, Lille, Lens, and Cambrai, to La Fère on the river Oise. From there it bent gradually to the eastward past the battle-scarred cities of Soissons, Reims, and Verdun, and thence to the Swiss frontier. During the winter the Germans made the most elaborate preparations to win a military decision in the west before the full force of the United States could be felt in action. "If the enemy does not want peace," declared the Kaiser in December 1917, after it became evident that France and Great Britain would not accept a "German" peace, "then we must bring peace to the world by battering in with the iron fist and the shining sword the doors of those who will not have peace." This was not an idle boast, because the peace with Russia had just released a huge army of the Kaiser's veterans for service on the western front.

Since 1916 Hindenburg had been the chief commander of the German armies, with General Ludendorff as chief of the general staff and the real strategist of the vast German military organization. On March 21, 1918, the great offensive prepared by these two was launched in the devastated region of the Somme River, with terrific effect. In a few days the German troops overran the entire territory which the British and French had captured with such great labor and cost in lives during the previous summers. They even pushed the Allied troops back of the old lines for a total gain of 35 miles. About 2,000 Americans, in small units of engineers, medical officers, and aviators, did good service with the British in resisting this drive. The Allied losses in prisoners and guns were very large, and the roads of central France were again filled with homeless refugees from the invaded regions. In front of Amiens, however, the Allied troops held fast and thus prevented what threatened to be an overwhelming disaster. "The prize of victory must not and will not fail us; no soft peace, but one corresponding with Germany's interests," were the words of the Kaiser at this time.

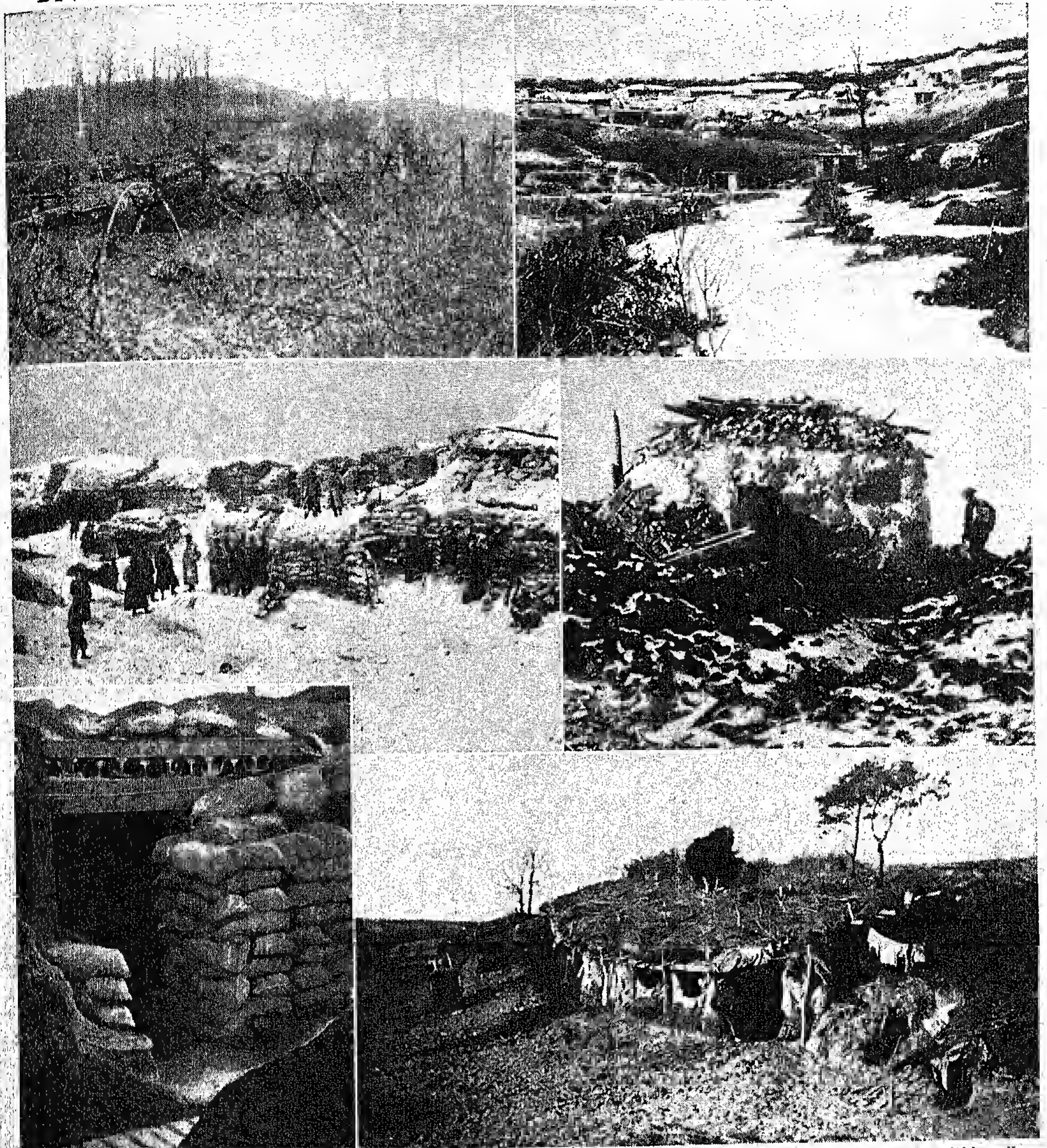
Foch Made Commander-in-Chief

It had been one of the most anxious weeks of the war for the Allies, whose chiefs finally recognized that something must be done to unify the activities of the Allied troops, in order to prevent if possible a break of the line when the terrible German onslaught should be repeated. It was unanimously agreed, March 26, 1918, that General Foch, now the commander of the French forces, should "coördinate" the operations of all the Allied armies on the western front, and three weeks later he was formally made commander-in-chief of the Allied armies.

So grave was the situation that American troops, although not yet battle seasoned, were now to be used in combat units. Thus far American troops, except in scattered training units, had not held front-line positions in any active sector; but within a few weeks American divisions were to operate in the battle line beside the French veterans.

The Somme offensive continued until April 6, when the German advance spent itself (*see* Somme River). On the 9th the Germans attacked again, along the Lys River south of Ypres, where they threw the British back for about ten miles. Then the fighting slowed down for about six weeks. It was only the lull before another storm, which broke on May 27. The scene was the old battleground of the Aisne River (*see* Aisne River), and the Germans were now under the personal command of the Crown Prince, who was put forward

LIVING UNDERGROUND TO ESCAPE AIRPLANES AND ARTILLERY



Probably visitors to the front were most impressed by its desert-like appearance, as though not a man or animal were within miles. Yet thousands of men would be present, concealed underground. The top pictures illustrate this with a view (left) of the grim front of a western front position, and (right) the "dugout city" on its rear slope (taken in 1919, with camouflage removed). French dugouts (middle left) in Champagne show white ground caused, not by snow, but by chalk dust. At the middle right is a German pillbox, or concrete machine-gun emplacement, captured by the Canadians. "Elephant" (corrugated) iron and rails protect the roof of the front-line dugout (lower left). Last, an artillery stable, with its roof covered to blend with the ground, shows "concealment" camouflage.

to deliver the blow that should crush the Allies and compel them to beg for peace. Like a flood the Germans overwhelmed the French positions between Soissons and Reims. For a week the French retreated, until the battlefront was again on the Marne River at Château-Thierry, only 44 miles from Paris. Then it was that large forces of Americans made their first appearance, and proved their fighting ability, notably at Cantigny, Château-Thierry and in counter attacks at Belleau Wood, Vaux, and Bouresches.

The Germans soon renewed the drive, hoping this time to capture Compiègne, thus placing themselves in position to strike the blow which would deliver Paris itself into their hands. But the French stopped

them after losing only a little ground, and the Germans now needed a breathing spell.

On July 15, they started another drive west of Reims, which developed into the second battle of the Marne (*see* Marne River). But now came the turn of the tide. General Foch had been biding his time, relieving veteran troops in quiet sectors with newly arrived Americans, and forming these veterans and the more seasoned American divisions into a general reserve. By attacking from one side of a salient, the Germans had laid themselves open to attack from the other—and on July 18 Foch seized this opportunity. French and American troops crushed in the western flank of the salient from Château-Thierry north, and the Germans had to run for the Aisne to avoid capture, yielding Soissons on August 2, with the 1st, 2d, 3d, 4th, 26th, 28th, 32d, 42d, and 77th American divisions among the pursuers. The 42d, 3d, and 28th previously had taken part in the resistance which stopped the attack of the 15th. This action was known as the Aisne-Marne operation.

The Allies Take the Offensive

The most important feature of Foch's offensive was that it did not stop. Before the Germans could recover from the Marne defeat, the British on August 8 opened a drive along the Somme. In this offensive (the second battle of Amiens), the Canadian corps, in the center, drove forward eight miles on the first day. This is believed to be the greatest single day's advance against resistance in the war. Two weeks later Albert and Bapaume were recovered. In little more than a month the Allies took 100,000 prisoners and the Germans were in full retreat.

Now the Allies had the Germans in a large-scale trap, if they could contrive to close it. The main German mass was west of a line from Antwerp to Metz, and their best hope of safety lay in retreating to this line. But behind the middle of the line lay the difficult wooded Ardennes Mountains; so the only avenues of escape were through Belgium, and to the south through Metz. These avenues the Allies now strove to close.

On October 9, after a fortnight of hard fighting, the Canadians took Cambrai. Even the little Belgian army, assisted by the British, now began a drive which in a few days won more territory from the Germans than the British had been able to gain in four months during the previous year. The recovery of French and Belgian towns, including Ostend and other North Sea coast cities, which for four years had been under German domination, now followed in quick succession. Lille fell to the Allies on October 17, and farther to the south the strongholds of La Fère and Laon were taken.

To the south, the main blow was entrusted to the Americans, who, for the first time, were to operate as an independent army. To clear the way for the final drive, the Americans (September 12–13), cut off the Saint-Mihiel salient, which menaced all communications in the Verdun sector (*see* Saint-Mihiel). The big drive through the Argonne Forest, then northward along the Meuse from Verdun to Sedan, then commenced, on September 26 (*see* Argonne Forest). Continuing through October and into November, the French and Americans moved northward towards Sedan, fighting every inch of the way over the roughest terrain, until they cut the railroad lines through Sedan, and the French entered the town November 7, thus severing the German army's line of supplies.

Collapse of Germany's Allies

While Germany was receiving these staggering blows, her allies everywhere were collapsing. Bulgaria, the last to join the German cause, was the first to leave it. For three years an Allied army at Saloniki, composed of miscellaneous detachments of British, French, Italian, and Serbian troops, with a force of Greeks under Venizelos, had been stationary and apparently useless. It was an army of considerable size, but its commanders hesitated to advance for fear of being attacked in the rear by the pro-German Greek king, Constantine. But on June 12, 1917, Constantine had been forced to abdicate, and Venizelos was able to bring the whole force of Greece to the side of the Allies. Suddenly, Sept. 15, 1918, the Allied army moved forward, and the Bulgarians, Austrians, and Turks fell back. In less than two weeks most of southern Serbia had been recovered, and Bulgaria was threatened with invasion. To avert this, Bulgaria asked for an armistice, which was signed September 30. She agreed to cease hostilities, to demobilize her army, and to surrender all means of transportation in Bulgaria for the use of Allied troops.

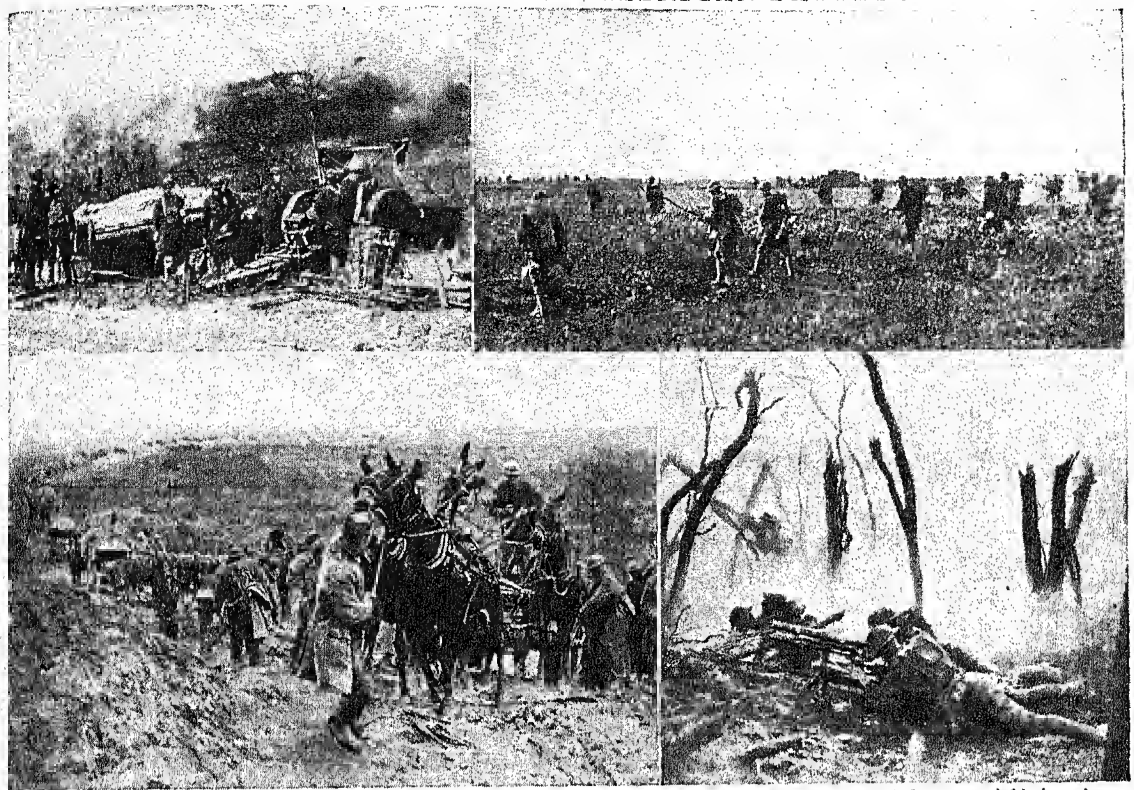
After the armistice with Bulgaria, the Serbian army continued its triumphant progress northward. Nish (Nis) and other cities fell, and the Austrians fled from Albania and Montenegro. Finally, after a campaign lasting less than seven weeks, Serbia was entirely cleared of Austrians.

A few days after this Balkan campaign began, General Allenby's army, which had taken Jerusalem, attacked the Turkish army in Palestine. Within two weeks it captured 71,000 prisoners and advanced 175 miles northward. Historic towns, including Damascus, Acre (Akka), Tyre, Sidon, Beirut, and Aleppo, fell in rapid succession. The Turkish government was in a panic and hastened to follow Bulgaria by surrendering October 31. The terms of the armistice imposed on her were similar to the Bulgarian conditions. In addition the Turks agreed to open the Dardanelles and Bosporus straits to the Allies.

The Italians "Come Back"

More dramatic perhaps than any of these campaigns—certainly far more important—was that begun by the Italians October 24. For a year the Italian army had apparently lain stunned behind the low banks of the Piave River. But a new spirit had now been breathed into the Italian ranks; the voice of pro-German and "defeatist" propaganda was stilled and the Italians longed to retrieve the disaster of the previous year. The time seemed propitious because

GLIMPSES OF FAMOUS AMERICAN BATTLES



At the upper left is a 155-mm. howitzer, firing from a temporary position during the Meuse-Argonne drive. At the upper right, Americans are going over the top in their attack on Cantigny. In the Saint-Mihiel operation, traffic congestion caused more trouble than the Germans did. Note (lower left) how one balky mule team blocks half a mile of vehicles. Last we see a 37-mm. gun crew in action against a machine-gun nest, during the terrific fighting of the Meuse-Argonne offensive.

the Germans could lend no assistance, being hard pressed in France and Belgium.

The Italians were successful beyond all their expectations. By advancing across the upper Piave in the battle of Vittorio-Veneto (October 27–30), they practically severed the connections between the Austrian troops on the plain and those in the mountains. The Austrians were straightway thrown into a hopeless panic. Within ten days over 300,000 of them surrendered, and the Austrian commander begged for a cessation of hostilities.

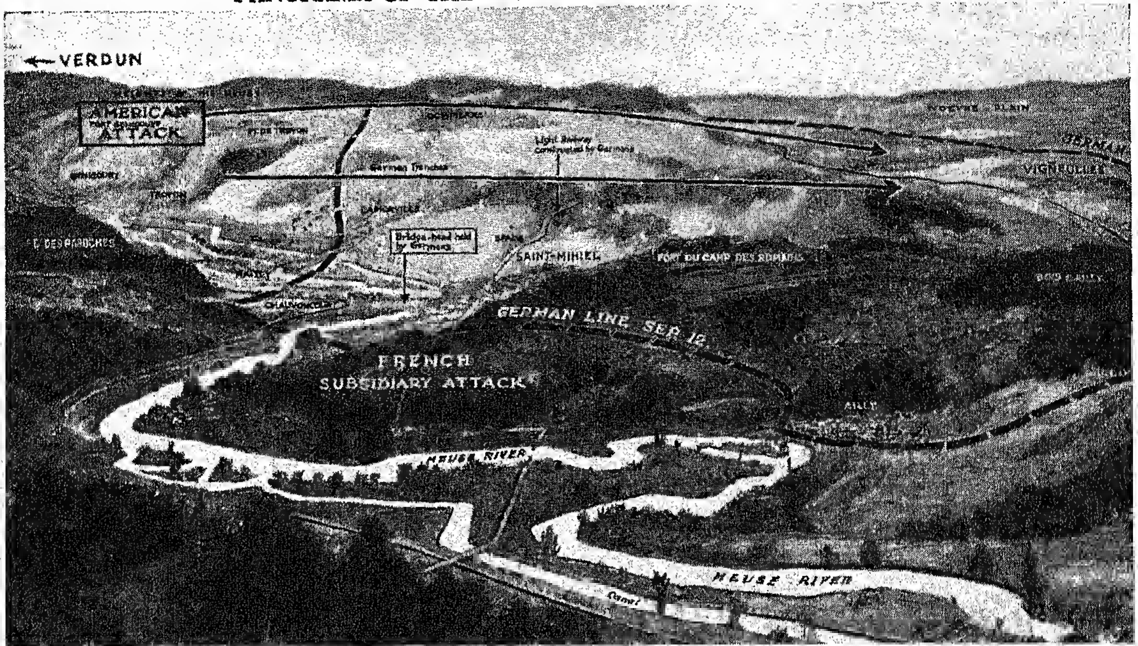
The armistice granted to Austria-Hungary on November 3, which took effect November 4, required her to demobilize her army, to surrender large strips of territory, to give up one-half of her military equipment and nearly the whole of her navy, to expel German troops from within her borders, and to permit the Allies free use of her railroads. These rigorous terms amounted to unconditional surrender.

The collapse of the Austrian army was accompanied by the collapse of the government at home. The long-expected break-up of the dual monarchy of Austria and Hungary, formed in 1867, came when Bohemia and other parts of the Hapsburg dominions, which for years had longed for freedom, joyfully proclaimed their independence. The heads of the proud and ancient house of Hapsburg, which for centuries had ruled over the destinies of a vast empire, fled to Switzerland for safety.

Collapse of Germany

Even before all these disasters, Ludendorff on September 29 had told the German rulers that the situation was hopeless. Prince Max of Baden was made chancellor, and on October 3 he requested an armistice. While the Allies were discussing terms, the "home front" within Germany was crumbling as well as the front presented by the armies. This was aided in no small measure by skilful Allied propaganda. Within Germany, this had been distributed for some time by the Independent Socialists, backed by money and other aid from Bolshevist Russia. In the spring, Allied airplanes had dropped leaflets over the Austrian lines, promising independence to national minorities. After July, maps showing Allied gains and strength were dropped upon German troops and in the larger industrial centers. Since the statements coincided with the soldiers' own experiences, they had wide effect. Disorder broke out in the German fleet at Kiel on November 3, and it spread rapidly to Hamburg and Bremen. The Socialists in Berlin refused to support the government any longer, and rulers of the two important kingdoms of Bavaria and Württemberg

PANORAMA OF THE SAINT-MIHIEL SALIENT, TAKEN BY THE AMERICANS



Since 1914 the Saint-Mihiel salient had been held by the Germans, like a pistol pointed at the heart of France. In their attempts to take it, the French lost hundreds of thousands of men, without result. General Pershing always wanted the first major American operation to be its capture, and after the Aisne-Marne counter attack had succeeded, Marshal Foch ordered this done. The salient had a front 50 miles long and was 12 miles deep from its tip at Saint-Mihiel to its base on the line between Verdun (left) and Pont-à-Mousson (right). The artillery preparation started at 1:00 a.m., September 12,

abdicated. After hearing of these alarming events the Kaiser himself abdicated at Spa on November 9, and fled to Holland. Everywhere the hereditary princes of the German states resigned their crowns or were overthrown by revolution.

A temporary government was immediately formed at Berlin, which arranged for a national convention to be held at Weimar to form the republic.

The Armistice and Its Terms

By now the Armistice terms were ready and the Germans were called to receive them. A delegation crossed the lines and was taken to Marshal Foch's railroad traveling headquarters near Compiègne. At daybreak, November 11, they signed. Six hours later, at 11:00 a.m., the guns ceased to fire. (*See* Armistice.)

The terms of the Armistice were hard. President Wilson had warned the Germans that they would be such as "to make a renewal of hostilities on the part of Germany impossible." The German army was required to retire to a line about six miles east of the Rhine River, allowing the Allied troops to occupy the evacuated territory together with the three "bridge-heads" of Mainz, Cologne, and Coblenz; to surrender the bulk of the German fleet, including all submarines; to surrender vast quantities of military supplies, including 5,000 cannon, 25,000 machine guns, 5,000 locomotives, and 150,000 railroad cars; to renounce the treaties imposed on the Russians and the Rumanians earlier in the year; to surrender all their prisoners; and finally to agree to pay for damage done.

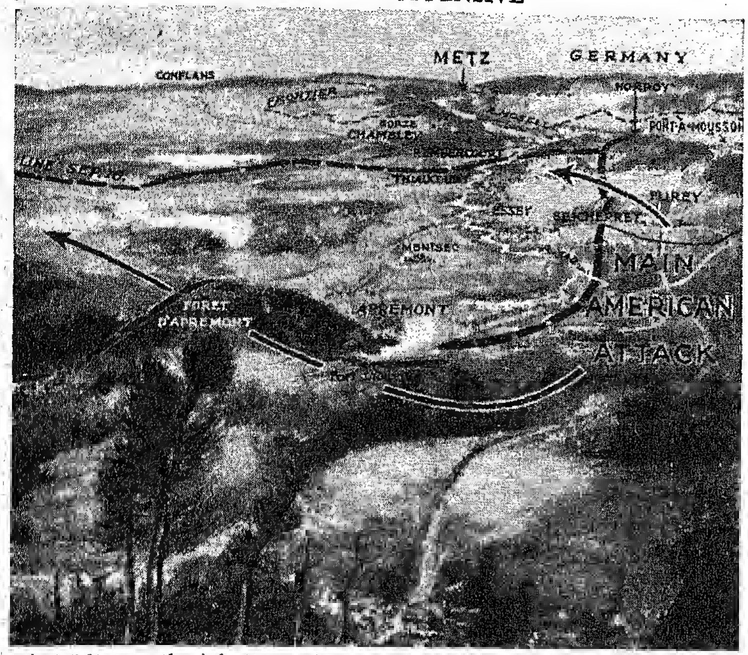
The Germans commenced withdrawal at once, and the Allied troops followed closely without trouble. The war now definitely was at an end. There remained the colossal task of planning an acceptable peace.

How the World War Came to the United States

PRESIDENT Washington took the stand that the wars of Europe ought not to be considered as the business of the United States. In 1793, when France and England renewed their long struggle for supremacy in Europe, he declared neutrality, promising to remain friendly with both, and to give aid to neither. As a neutral, he claimed for the United States the right to continue its trade with both warring countries, except in so far as international law clearly permitted them to interfere with it. (*See* Neutrality Policy of the United States.)

One hundred and twenty-one years later, President Wilson found an unbroken precedent for proclaiming neutrality when in 1914 the World War came to threaten civilization with destruction. It was hard for Americans to believe the fact of war in 1914. That a European war should involve the United States was scarcely to be imagined. And it was easy to believe that the cause of the great struggle was the rivalry of the European nations, their race for imperialistic possessions, and their competition in armies and navies that had turned Europe into an armed camp.

IN THEIR FIRST "ARMY SIZE" OFFENSIVE



and at 5:00 a.m. the infantry went over the top. The main body assailed the southern face, and included in its mission capture of the dominating hill near the village of Montsec, from which since 1914 the Germans had watched every movement in the low-lying Allied position. A supporting attack at the north closed escape that way, and at 3:00 a.m. on September 13, patrols from the two attacks met at Vigneulles.

The United States, with no compulsory military training, had a small standing army, and a navy none too large for the two coasts that had to be defended, and no thought at all of an offensive war. To keep out of the European war was the expectation of a people who believed that wars are generally wrong; it was even more the hope of the multitudes, newly arrived in the United States, whose relatives were in every country of Europe, and whose affections and loyalties, apart from their greater loyalty to the United States, were with the nations of their ancestors.

How the World War revealed itself to all of these, how the conviction arose that the Central Powers were in the wrong, how it became clear that the United States could not remain a neutral and be safe, make up the story of how the war came to America.

How America Felt When War Broke Out

The quarrel of Austria with Serbia seemed too slight a cause to provoke so great a war. When Germany suddenly crossed the frontiers of Belgium, and wrecked a small and friendly country, she showed that the German armies were the best prepared in Europe; but it seemed in the United States that a great wrong had been done, and that every peaceful nation ought to sympathize with Belgium. It was soon believed that Germany and Austria had prearranged the war, launching it when they were ready. Maps on sale in German book shops, showing the gains that Germany expected to make, strengthened this belief.

After the war, the historians showed that the war was indeed due to the rivalry of the European nations, and that Germany, careless at first, tried too late to stop it. But she invaded Belgium on her way to France; and every shipload of food sent by America to feed the Belgians made it easier to believe in German guilt. Both the Allies and the Central Powers tried by propaganda to convince the United States that they were entirely in the right. Because the Allies, Great Britain and France, controlled the cables and the mails, it was hard to get the German side of the story before neutral countries. Germany was charged with terrible atrocities committed against innocent men, women, and children; these could not be verified, during the war or since. But it was easy to believe them; and the devastation of Belgium was a reality. Opinion in the United States, content to preserve the political neutrality of the country, tended to hold that if the Allies were not entirely right, Germany at least was wrong. The militaristic government of Germany was in contrast with the more democratic forms of government in Great Britain and France. This contrast, too, suggested that here was a war of military autocracy against democratic governments, and that the place of the United States was on the side of the Allies.

More certain matters affecting American opinion were the inconveniences to which United States ships and cargoes were subjected. The Allies searched vessels, interfered with the mails, and stopped trade with neutral countries in Europe on the ground that the goods might be intended to go into Germany. Their acts were irritating, and often illegal. German sympathizers complained because the Allied control of the seas prevented Germany from buying munitions of war in the United States; and said that since Germany could not buy, the United States ought not to sell similar goods to the Allies. But President Wilson insisted, and international law upheld him, that citizens of neutral countries have a right to sell munitions to either belligerent, subject, however, to the right of the other belligerent to stop and seize them on the way. Germany's lack of sea power gave the Allies a great advantage on the seas, but it was not the duty, or the right, of the United States to redress this.

In retaliation for the pressure imposed upon them by the Allies, the Germans utilized a new weapon in the form of the submarine (*see* Submarine). In February 1915, they declared their intention to sink merchant vessels when found in British waters, without giving warning in advance. There was serious disagreement even in Germany as to the wisdom of

submarine warfare, but it was adopted as a method of driving the Allies to sue for peace. This plan was contrary to existing international law, which forbade attack on a merchant ship unless it resisted lawful search, and protected civilian passengers and crew as noncombatants whose lives should not be recklessly endangered. The German defense was that unrestricted submarine warfare was the submarine's only way of dealing with armed merchant ships. After the sinking of the *Lusitania*, May 7, 1915, Germany for a time refrained from similar attacks. But on Feb. 1, 1917, she announced the withdrawal of all pledges, and declared that she would sink on sight all merchant vessels, enemy or neutral, found near the British coast. President Wilson dismissed the German ambassador, Count von Bernstorff, and recalled the ambassador to Germany, two days later.

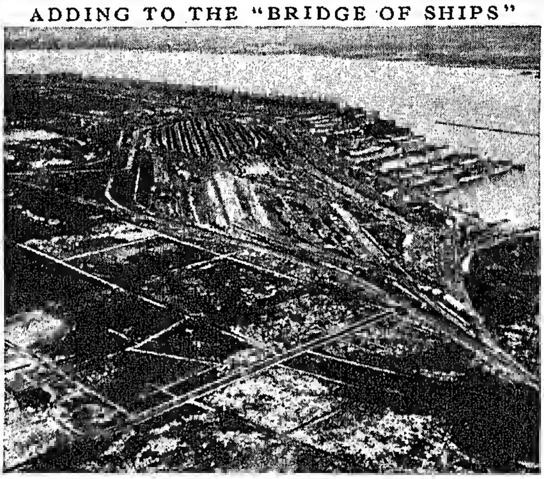
The Campaign for Preparedness

American opinion, at first neutral, came to believe Germany in the wrong, and then to believe that democratic government would be unsafe if Germany won. The drift into war against the Central Powers became stronger. President Wilson and Congress saw this, and made preparations along two lines: to urge upon the countries at war a peace that would be just, and to increase the military and naval strength of the United States. (*See* Wilson, Woodrow.)

The preparedness movement, which called for army and navy increases, began with the outbreak of the war in Europe, but President Wilson did not encourage it so long as he believed the neutral rights of the United States could be protected without force. Ex-President Roosevelt was one of the most active of the preparedness advocates. After the sinking of the *Lusitania*, the President took the lead in the movement. Congress in 1916 passed the National Defense Act, enlarging the army and providing for officer training. Later in the year it passed the greatest appropriation bill thus far enacted for building battle cruisers, battleships, destroyers, cruisers, and submarines, so that by 1920 the United States might possess a navy second to none. Thereafter, the United States would not be forced to submit to any belligerent's interpretation of international law. The United States Shipping Board was created in 1916, to build and operate merchant ships, to take the place of foreign ships drawn out of transoceanic service.

In August 1916, Congress created a Council of National Defense, to be composed of the secretaries of war, navy, interior, agriculture, commerce, and labor, assisted by an advisory commission of seven civilians. Walter S. Gifford was director of the council; Samuel Gompers and Julius Rosenwald were among the civilian advisers. The council was to prepare for mobilization of the civilian population, and for "the coördination of industries and resources for the national security and defense." At the same time the production and distribution of food and fuel were placed under national administrators, Herbert C. Hoover and Harry A. Garfield, with almost dictatorial powers; and the railroads were placed under a federal director-general, William G. McAdoo.

ADDING TO THE "BRIDGE OF SHIPS"



Here is an airplane view of the Hog Island shipyard, created by the United States to help replace shipping destroyed by German submarines. Yet huge as it was, this plant was only one small item in the effort America made to win the war.

While the preparedness measures were being enacted, President Wilson strove to lead the countries to peace. He had offered to mediate early in the war, but apparently all the powers were confident of winning and declined his services. Through his special agent and friend, Col. E. M. House, he kept in touch with the rulers of the chief belligerents. Most victories in 1915 and 1916 were German victories; and just before Christmas 1916, Germany urged her enemies to negotiate a peace. At the same time President Wilson invited all of the belligerents to state the lowest terms they would accept. When he received their replies, he made a famous speech to Congress, urging the countries to a "peace without victory"; because any other kind of peace would sow grievances and prepare the way for other wars. He had already in 1916 said that after the war there ought to be a league to enforce peace, to prevent any country from trying to conquer its neighbors, and to settle honest disputes by arbitration. And if such a league should be constructed, after a just and moderate peace, he promised to urge the United States to join it.

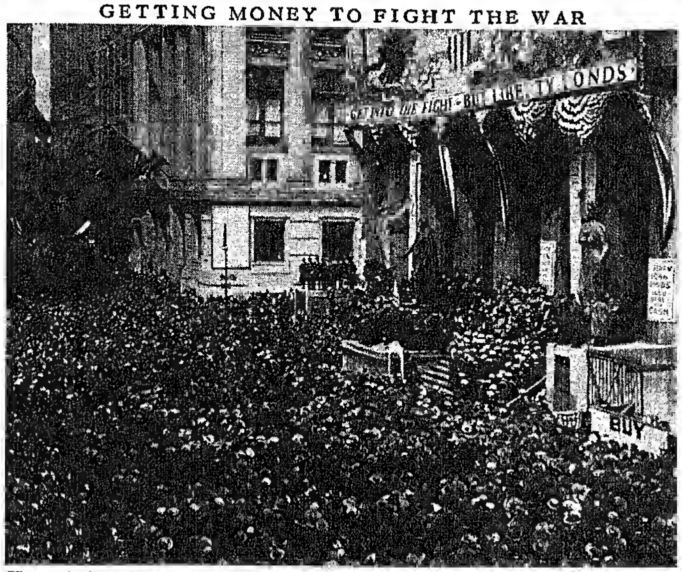
A "World Safe for Democracy"

There was no favorable response to President Wilson's move for peace. Instead, after her peace proposals failed, Germany resumed unrestricted submarine warfare, and the United States was forced to enter the war. For Americans of German or Austrian descent it was a tragic situation, but most of these took their stand with the great bulk of Americans.

President Wilson was inaugurated for his second term March 4, 1917. He called Congress to meet in special session, and on April 2 he read to it his message stating that war had already begun by the acts of Germany. The stated aim of the United States in entering the war was to make a "world safe for democ-

racy." There was no quarrel, he said, with the German people, who had contributed millions of good citizens to the United States; but he believed their government to have caused the war and to have fought it in violation of international law and the dictates of humanity. There could be no truce with it until it was placed in such a condition that it could not again endanger the peace of the world. Congress supported him, with few opposing votes, declaring war on April 6, 1917, and proceeding at once to pass the laws needed to bring the whole military strength of the United States into action.

GETTING MONEY TO FIGHT THE WAR



Here, before the statue of George Washington on the steps of the United States Subtreasury at Broad and Wall streets, New York City, a seething crowd is being told why it must buy Liberty bonds. Similar scenes the country over, with house-to-house canvasses, raised over 21 billion dollars in five great "drives."

"Work or Fight"

It took more than fighting men to uphold a nation in the World War. It required its wealth, and the time and service of those who remained at home. In the 18 months after the declaration, the country was placed upon a complete war basis. Public opinion frowned upon non-essentials. It was "work or fight."

This unanimity of public opinion was due in no small measure to skilful use of all the arts of advertising and publicity as well as modern facilities such as newspaper and motion pictures (radio broadcasting was not then known). A Committee on Public Information issued newspaper articles, posters, and other material, explaining the issues of the war, urging economies in food, fuels, and other materials, and inspiring everyone to utmost effort. A nation-wide organization of so-called "four-minute speakers" gave talks at theaters, before clubs, and on all other possible occasions, until everyone understood, and was coöperating with, the national program.

Organizing the Army

No one knew exactly how many men there were of proper age, and capable of bearing arms. But on May 18, 1917, the Selective Service Act called for the registration on June 5 of all men between the ages of 21 and 31. Of these, 10,679,814 signed up at once; and when in 1918 the age limits were extended to include 18 and 45, there were 13,228,762 more registrations. Not all of these were wanted in the armies. Many were needed in industry. Many were physically unfit, or had too many dependent upon them to go. But nearly 4,800,000 men were taken into military service. Of the 93 combat divisions which were organized, 42 in all reached France, and 30 saw service in the line. The numbers below 26 were assigned to divisions made up chiefly from the regular army. The numbers 26 to 42 were assigned to National Guard divisions. Numbers above 75 were given to the national army, as the draft units were called, but after the summer of 1918 the term national army included all forces.

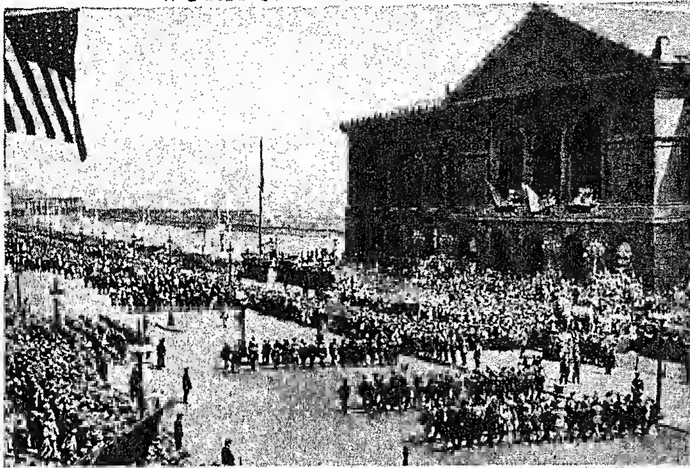
There were needed about 200,000 commissioned officers to drill and lead the troops. About half of these were trained hurriedly in officers' training camps; over 40,000 physicians and surgeons and dentists received commissions, and most of the remaining officers came from the ranks of the regular army or from the National Guard. Political appointments to high command, such as had prevailed in the Civil War, did not occur. Even ex-President Roosevelt, distinguished as he was, but not a professionally trained soldier, and past effective military age, was denied command.

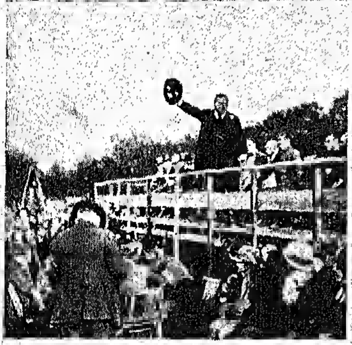
Difficulties and Troubles

The roster of names in many a battalion sounded like a directory of Europe; but regardless of his father's nationality the American soldier proved to be an American. These millions, from every walk of life, were concentrated in training camps. There were tent camps to be built in the South, and permanent cantonments wherever needed. To build the camps in a hurry taxed the resources of the building trades and of the railroads.

The men required clothing, food, and weapons, as well as proper medical attention in camp and overseas. To procure these the Council of National Defense was summoned for advice, and set up in the summer of 1917 a War Industries Board that watched the contracts and tried to regulate the flow of all the materials and commodities that were called for. There was much confusion, for nearly everyone was engaged on a job that he had never filled before. There was special difficulty when the needs were for elaborate machines that had to be designed and made in factories that did not yet exist. Airplanes caused much trouble. Artillery was slow. Gas, and the equipment for its use, could not be hurried.

WORKING TO BUILD AN UNSHAKABLE "WILL TO WIN"





From the outset of war, an unremitting, powerful effort was made to maintain unceasing work for victory. Impressive parades sent drafted men to training, as in Chicago (upper left), while celebrated speakers like ex-President Roosevelt (lower left) addressed meetings. Posters by noted artists, like those shown, for the Victory Liberty Loan and the Red Cross, appeared everywhere. The last picture shows Secretary of War Baker drawing a number to decide the order of service for drafted men.

By Christmas, when volume production was beginning to get under way, the railroads had more business than they could handle, the port equipment was scanty, and the weather was the worst in many years. Excessive cold held up traffic and raised a question whether there would be coal enough. The Fuel Administration stimulated production of coal and restricted its use. In January 1918, there were "coal-less days," on which ordinary factories closed down to save fuel. The Food Administration had been at work since the summer of 1917, urging greater production of food, and teaching the population that remained at home to go without sugar, wheat flour, meat, and fats, in order that these foods might be shipped abroad.

Obtaining Ships and Money

But there was a scarcity of ships in which to send men, munitions, and food, for the German submarines had destroyed a large number of the Allied merchant ships. The United States Shipping Board began to order ships in great numbers. Experiments were being made in feverish haste with steel, wood, and even reinforced concrete ships. Best results came from standard type "fabricated" steel ships, most of whose parts could be made at ordinary steel plants and then assembled at the shipyard. At Hog Island, in the Delaware River flats below Philadelphia, over $60,000,000 was spent in building the world's greatest shipyard; 50 shipways were built in a single row.

The war called for money almost without limit, not only to pay the expenses of the armies of the United States, but to assist the Allies who were drained after three long years of war. Almost at once the Treasury began to lend money to the associates of the United States in the war, and nearly $10,000,000,000 went this way before the war was over. There had to be loans for home needs. Four "Liberty Loans" were arranged to sell United States bonds, and there was a fifth, a "Victory Loan," after the fighting ceased. By means of these, more than $21,000,000,000 was advanced to the United States government. Taxes were increased, using heavily the new income tax, in an effort to pay as large a portion of the war cost out of current taxes as possible. About one-third was

raised this way, making the war more nearly a "pay as you go war," than is usually the case.

An American Front in France

Because of all the preparations that had to be made, the World War ran on a full year after the entry of the United States before American aid was visible in France. The Allies, wearied, were just holding on, waiting for help. They could not be beaten, but they could not win.

The navy was first to help in a direct way. Admiral William S. Sims was sent to London in the spring of 1917, and was followed by a fleet of destroyers that went to work at once. It was a thankless and dangerous job, holding the blockade, chasing submarines, and convoying merchant ships. Several of the United States battleships joined the British fleet. Probably the greatest service rendered by the navy was in laying a barrage of contact mines across the English Channel, and also closing the northern outlet of the North Sea from the Orkney Islands to the coast of Norway, 230 miles. Before the end of the summer of 1918, more than 50,000 mines were laid. (*See* Torpedoes and Mines.) The submarine was bottled up, and no large American troop transport was destroyed by submarine attack.

For the command of the American army in France Gen. John J. Pershing was selected. The first combatant unit of American troops had reached France on June 27, 1917, and a few days later General Pershing arrived in Paris. "You have come, God bless you!" said Marshal Joffre to Pershing as he stepped from the train. On July 4, American troops marched through the streets of Paris amid scenes of indescribable joy on the part of the people. That same day General Pershing laid a wreath of roses on the tomb of Lafayette, and was reported to have uttered these simple but eloquent words: "Lafayette, we are here" (*Lafayette, nous voilà*). The sentiment was certainly that of General Pershing's address, but the words quoted so widely were actually spoken by one of his staff officers, Lieut.-Col. Charles E. Stanton.

However, much remained to be done before the Americans could lend powerful aid. The British and French believed that neither General Pershing nor other American higher officers had the knowledge and experience necessary to control large-scale troop operations in the type of fighting then being done; so they wanted to incorporate American troops by battalions and regiments in their own divisions. General Pershing insisted upon forming an American army, and set about the colossal task of providing for it. Since the British would hold the northern line near the Channel ports and the French would cover Paris, he planned to take the sector south of Verdun, and to use the ports of Brest, Saint-Nazaire, and Bordeaux on the Atlantic coast and Marseilles on the Mediterranean for his supplies. This meant building or improving railroads from the ports to the sector (for all French main-line railroads centered in Paris), and erecting barracks, hospitals, supply depots, construction and repair shops, and schools and training areas for all the different arms of service. His own headquarters were established at Chaumont.

First Appearance at the Front

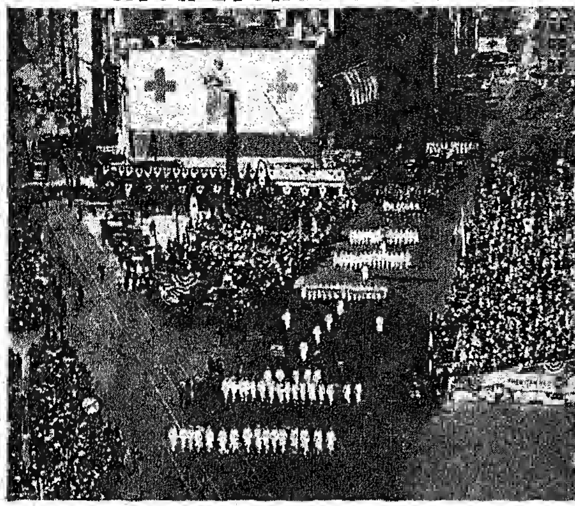
Soon the French ports were bustling with men creating these facilities, and ships unloading troops—a small trickle of these at first, then more and more as facilities increased and ships were found. The troops vanished into their training areas, where grueling weeks or months were spent perfecting their training; and as each division was judged ready, it was given a tour of duty in a quiet sector, to learn trench life and become accustomed to the presence of an enemy. Then the division was judged ready for hard fighting. The first American division to enter the line under this arrangement was the 1st, which took over a quiet sector in Lorraine, firing its first shot Oct. 23, 1917.

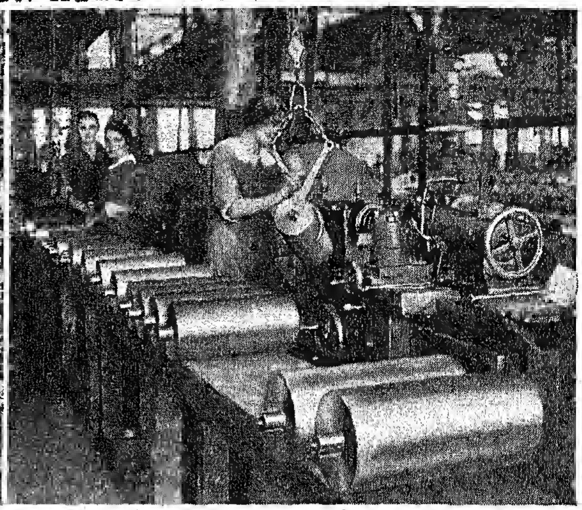
In all, some 20,000 freight cars and 1,500 locomotives were shipped in sections to France and assembled there by railway engineers. Every combat division,

TEACHING THE NATION THAT "SAVING MEANT VICTORY"

Food saving, perhaps, was stressed most throughout the nation, as evidenced by the Washington, D. C., community demonstration of cooking without waste. At the left is a poster urging saving of coal, and at the right humble "junk" is the theme.

HIGH LIGHTS ON HOW WOMEN HELPED TO WIN THE WAR





Here we see only two of the countless contributions women made to victory: an impressive parade crossing Madison Square, New York City, May 18, 1918, during a Red Cross drive, and (right) some of the thousands who went into munition making.

about 30,000 men—and by the Armistice, some 40 divisions were in France—required 25 carloads of supplies for its daily consumption. All of this vast enterprise, of providing food and equipment, was performed by the Services of Supply ("SOS"). The chief purchasing agent was Gen. Charles G. Dawes, and after July 29, 1918, the commanding general of the SOS was Gen. James G. Harbord.

The Work of the A.E.F.

Soon after his arrival, Pershing reported to the War Department that fewer than 1,000,000 men could not make an army, and that his plans required 4,000,000 men as soon as they could be shipped. The American Expeditionary Forces (A.E.F.) beginning to gather slowly in France in June 1917, reached about 300,000 men, when on March 21, 1918, the German armies plunged into the battle of the Somme. The Americans came, in theory, by divisions of about 30,000 fighting men; but in fact they came as ships could be found to move them, some fully equipped, some who had not even been taught to load their rifles. For a year after the United States entered, England, who owned the ships, was slow to lend them for this purpose. Only parts of four divisions had been in the line on March 21, 1918—the 1st, 2d, 26th, and 42d. These were offered to be used as needed when the line wavered during the first week of the German drive on the Somme. The ominous danger of German success did two things: it induced England to consent to the appointment of Foch as commander-in-chief of the Allied armies, and it induced her to provide the ships to ferry the A.E.F. to France. Through the five months after April 1918, nearly 10,000 American troops a day were sent to France, and Pershing's force became a reality.

The temper of the A.E.F. was tested in the early summer. There had been raids upon American trenches, one of them a formidable mass attack upon the 26th division at Seicheprey in April; but no deliberate demonstration of the power of a division of the A.E.F. was made until at Cantigny, May 28, the 1st Division took its objective and held it firmly against counter attacks. The battle of the Marne was already under way, and the next day the 2d and 3d divisions were hurrying towards Château-Thierry to help fill the gap caused when the French armies broke before the German advance. In the next two weeks the name of Belleau Wood was heard, where the Marine Brigade and the army regiments of the 2d Division did valiant service June 1–26. After this there were no doubts about the ability or willingness of the A.E.F. to fight.

Finally in August, General Pershing and the Allied commanders agreed on a plan of campaign in which the American First Army was to be used as a unit in a major offensive. As a preliminary operation the Americans were to aim at the reduction of the famous Saint-Mihiel salient, north of Toul, which the Germans had maintained doggedly ever since their first drive in 1914. The morning of September 12, after a four-hour barrage, in which the Americans were supported by heavy French artillery and colonial troops, the attack began at 5:00 a.m., and the salient was "pinched out" by morning of the 13th. Nearly 3,000 pieces of artillery and 1,500 airplanes gave the Americans overpowering superiority. The operation fully proved the usefulness of the First Army.

The elimination of the Saint-Mihiel salient was the prelude to the much greater battle to begin September 26, between the Meuse River and the Argonne Forest.

The battle of the Meuse-Argonne, which was "America's greatest battle," continued from September 26 until November 11, and used 29 combat divisions in its 47 days of action. It was part of a general engagement that pressed on the German line from Verdun to the English Channel (*see* Argonne

Forest). About 1,200,000 Americans participated; and when their drive ended, the war was over.

The cost of this American effort will never be entirely known. Americans killed in battle or dead of wounds numbered 53,381; illness and other causes brought the total deaths to 126,000; 234,300 had been wounded; and 4,500 were missing. On June 30, 1919, the government had spent more than $22,625,000,000 directly for the war, and in addition had lent its Allies more than $9,455,000,000; loans and expenditures growing out of the war were to continue for years. The indirect losses are beyond computation.

The Peace and Its Results

THE PEACE Congress which was to end the greatest war in history assembled at Paris in January 1919. There were representatives from all the countries which had been at war with the Central Powers. The important questions were settled first by the leaders of the five greatest powers—President Wilson, Premier Lloyd George of Great Britain, Premier Clémenceau of France, Premier Orlando of Italy, and (when Japanese interests were involved) Baron Makino of Japan.

One of the first tasks to which the delegates turned was drawing up a constitution for a League of Nations designed to reduce or abolish the likelihood of future wars. This "Covenant of the League of Nations" was made the first part of the Treaty of Versailles, which ended the war between Germany and the Allied Powers (*see* League of Nations). Other chief provisions were:

1. By the territorial terms of the treaty, Germany returned Alsace and Lorraine to France. The rich coal mines of the Saar basin were ceded to France for 15 years, under control of an international commission. Belgium was awarded the German frontier districts of Malmedy, Eupen, and Moresnet. Much of Posen and west Prussia were given to the new republic of Poland. The free city of Danzig was put under control of the League of Nations, and Memel with the surrounding territory was turned over to the Allied Powers. (Memel was given to Lithuania in 1924.) Germany also lost all her colonies, control passing to various Allied nations under mandates from the League of Nations. Part of the Cameroons, Togoland, part of German East Africa, and Nauru Island in the Pacific went to Great Britain. France shared in the division of the Cameroons. The Union of South Africa took over Germany's possessions in Southwest Africa, and Belgium took part of German East Africa. Japan was given a mandate over Germany's Marshall Islands, Australia assumed the same control of New Guinea, and New Zealand took over German Samoa. In addition to all this, Germany ceded her rights in Shantung to Japan. (In 1921 Japan restored Shantung to China.)

HOME AT LAST—VICTORIOUS

Like that other victorious force, the Grand Army of "Boys in Blue" of 1865, the 1st Division paraded Pennsylvania Avenue in Washington on its return home. This view was taken from the Treasury Building, and looks toward the Capitol in the distance.

2. Military clauses of the treaty were designed to make it impossible for Germany to attempt another offensive war. Her army was limited to 100,000 men; the manufacture of munitions was restricted to the needs of such a force; conscription was abolished; the fleet was restricted to a mere coast defense, with only six battleships, six light cruisers, and a few destroyers and torpedo boats. Germany was forbidden to have submarines or an air force, military or naval, and all her naval defenses within 50 miles of the coast were ordered destroyed.

3. The section of the treaty covering reparations demanded that Germany accept full responsibility for the war, and make reparations in cash and in goods for the damage she had caused. The amount was to be determined later by a special commission. The sinking by the German commander in June 1919 of most of the fleet which had been surrendered to the British at Scapa Flow in 1918, added considerably to the damages. Merchant vessels were to be given to the Allies to replace their vessels destroyed by submarines.

4. The treaty stipulated certain guarantees to assure that Germany would meet all her obligations. Chief of these was the provision that the Allies should occupy German territory west of the Rhine for 15 years. The mandates over former German colonies were part of the guarantees.

When the treaty was finally completed, the Germans were notified to send delegates to Paris to receive it. In the same hall at Versailles where the Germans had humiliated the French by proclaiming the German Empire in 1871, the treaty was handed to the head of the German delegation, May 7, 1919. The German delegates made most strenuous objections to the rigorous terms, pointing out their inconsistency with President Wilson's "Fourteen Points," which they claimed had been mutually accepted at the time of the Armistice. But the Allies made only slight concessions. "There must be justice," they declared, "for those millions whose homes and lands and property German savagery has spoliated and destroyed." Finally on June 28, 1919, exactly five years after the Austrian Crown Prince had been murdered, the German delegates affixed their signatures to the treaty.

Treaties with Austria and the Smaller Powers

In the meantime a treaty with Austria was arranged and was handed to the Austrian delegation, June 2, 1919. The head of the Austrian delegation, on receiving the treaty, addressed the Peace Conference in French instead of German, and declared that the new Austrian republic was free "from the horrible crime" of starting the war of 1914. He hoped thus to induce the Allies to modify the terms. The Allies made a few concessions, but in the main the Austrians suffered a severe punishment for their part in the war. The provisions of the treaty reduced Austria to a small country with six million people. It required her to recognize the complete independence of Bohemia, Hungary, and the Southern Slavs; to cede large districts including most of her coast line to Italy, with a good part of Hungary to Rumania; and to make reparation for the damage done during the war. The Austrians signed their peace treaty at Saint-Germain, Sept. 10, 1919.

Later treaties fixed the new boundaries of Turkey and Bulgaria. Bulgaria did not suffer greatly in loss of territory (Treaty of Neuilly, Nov. 27, 1919), but much of the former Turkish Empire, including Palestine, Mesopotamia (Iraq), Smyrna, and part of Syria, was turned over to the Allies, to be administered by them as "mandataries" of the League of Nations (Treaty of Sèvres, Aug. 10, 1920).

The United States Rejects the League

Various disputes protracted the exchange of ratifications, so that it was not until Jan. 10, 1920, that the German treaty was declared in force. Even then China and the United States were not included among those nations making peace with Germany. China objected to the cession to Japan of the rights previously held by the Germans in the Chinese province of Shantung. In the United States, because of a dispute which broke out between the majority in the Senate and President Wilson, the Senate rejected the act ratifying the treaty Nov. 19, 1919 and March 19, 1920 (*see* Wilson, Woodrow). The chief point in dispute involved the question of reservations to be made concerning the entrance of the United States into the League of Nations. The question was threshed out before the people of the United States in the presidential election during the autumn of 1920, and resulted in the election of the Republican candidate, Warren G. Harding, as president, with an overwhelming majority of Republicans in Congress. During the special session of Congress, called soon after, a resolution was passed by Congress and signed by the President (July 2, 1921) declaring the state of war between the United States and Germany and Austria-Hungary to be at an end. The United States then concluded treaties of peace with Austria and Germany, which were signed August 24 at Vienna and August 25 at Berlin.

Little Wars After the Big One

Throughout the period consumed by these lengthy negotiations, little wars, caused by impatience with the slowness of the diplomats, or dissatisfaction with impending results, were disturbing the general peace. Italy insisted on having the entire eastern coast line of the Adriatic Sea, including the port of Fiume, which was also claimed by Yugoslavia, a new country formed by the union of Serbia and Montenegro with the Slavic people of the southern and western parts of the former Austro-Hungarian monarchy. For a time an Italian filibustering expedition led by the poet-aviator D'Annunzio held the city and threatened a new war; but later (Nov. 12, 1920) the two countries agreed to make Fiume an independent city, and Yugoslavia obtained some of the disputed region. A later treaty (Jan. 24, 1924) gave Fiume to Italy.

The most serious upset to Allied plans came from Turkey, rehabilitated under the dictatorship of Mustapha Kemal (*see* Turkey). Greece, hoping to secure and enlarge her gains, started war in Asia Minor. The Turks crushed the Greek forces, and the Allies, finding Turkey too strong to handle, consented to replace the Treaty of Sèvres with one drawn at Lausanne (July 24, 1923) by which Greece lost all claims in Eastern Thrace and Asia Minor (*see* Greece).

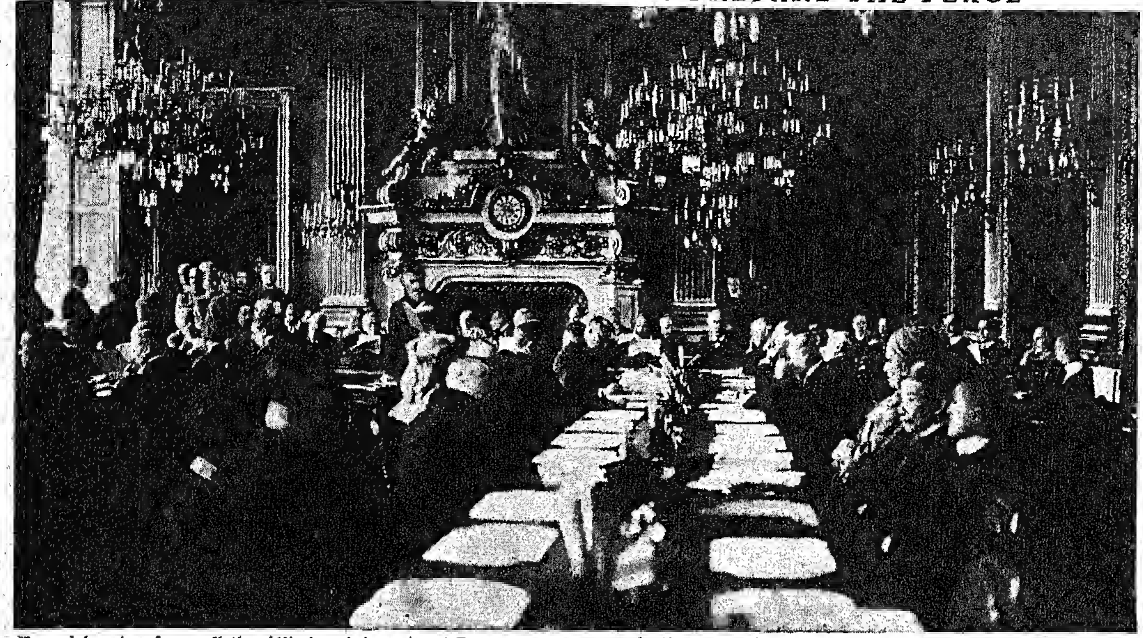
Meanwhile, Arab outbreaks had presented continuous difficulty for the French in Syria, culminating, in October 1925, in the French bombardment of Damascus (*see* Syria). The Poles occupied Upper Silesia in defiance of the peace treaty and a plebiscite favoring return to Germany. October 12, 1921, the League of Nations awarded Poland the best part of the region in dispute.

"White" Assaults on "Red" Russia

The bitterest and most protracted fighting, however, centered about Russia. In 1917, fearing the Bolsheviki and possible German use of Archangel, the Allies stationed some 15,000 British and Americans in that district, and had a force including 8,000 Americans in Siberia. Admiral Kolchak, an anti-Red, or "White," leader in Siberia, with the aid of the Czechoslovak Legion (Czech deserters from the Austrian armies who had fought with Russia), established an "all-Russian" government at Omsk, Nov. 18, 1918.

Two other "White" movements were led by General Denikin in southern Russia, and General

OPENING OF THE CONFERENCE TO PREPARE THE PEACE



Here delegates from all the Allied and Associated Powers are gathered in the great historic Clock Room of the Quai d'Orsay, listening to an interpreter translate the opening address given by President Poincaré of France. President Wilson is near the far wall, immediately to the left of the interpreter, as you view the picture. Such "plenary sessions," with all delegates present, were few, the real work being done in committees.

Yudenich in Esthonia. For a few weeks, in the summer of 1919, it seemed as if the Bolshevist armies, attacked on all sides, might fail. Then Yudenich was badly defeated within ten miles of Leningrad and Denikin was repulsed when he was almost within striking distance of Moscow. Kolchak lost Omsk, resigned his command, and was betrayed to the Bolshevists, who executed him Feb. 7, 1920. The Allied governments thenceforth abandoned their policy of "intervention" in Russia, although late in 1920 Allied ships rescued Baron Wrangel, who had succeeded Denikin in command in the Crimea, and transported the remnants of his army to Constantinople.

In addition to these troubles Bolshevist Russia was at war with Poland, which had been encouraged by a loan of $50,000,000 from the United States, and by shipments of French war supplies. In the spring and summer of 1920 the Poles were steadily driven back until their lines were in the outskirts of Warsaw. At this stage the Polish army was placed under General Weygand, Foch's chief of staff. By brilliant tactics he completely reversed the tide and within 60 days had cleared Polish soil of the Russian forces. The peace treaty, signed March 18, 1921, gave Poland a large slice of Russian territory, plus an indemnity of 30,000,000 gold rubles (about $15,450,000).

Problems of Industry and Finance

These military episodes were far overshadowed in importance, however, by the difficulty of reëstablishing commerce, industry, and particularly finance, on a normal peace basis. Roughly, the problem fell into three parts: restoring prosperity and normal finance within each country; obtaining reparations payments from the defeated countries; and settling interallied debts. The latter as a practical matter meant payments to the United States by the nations of Europe, since the United States was the ultimate creditor.

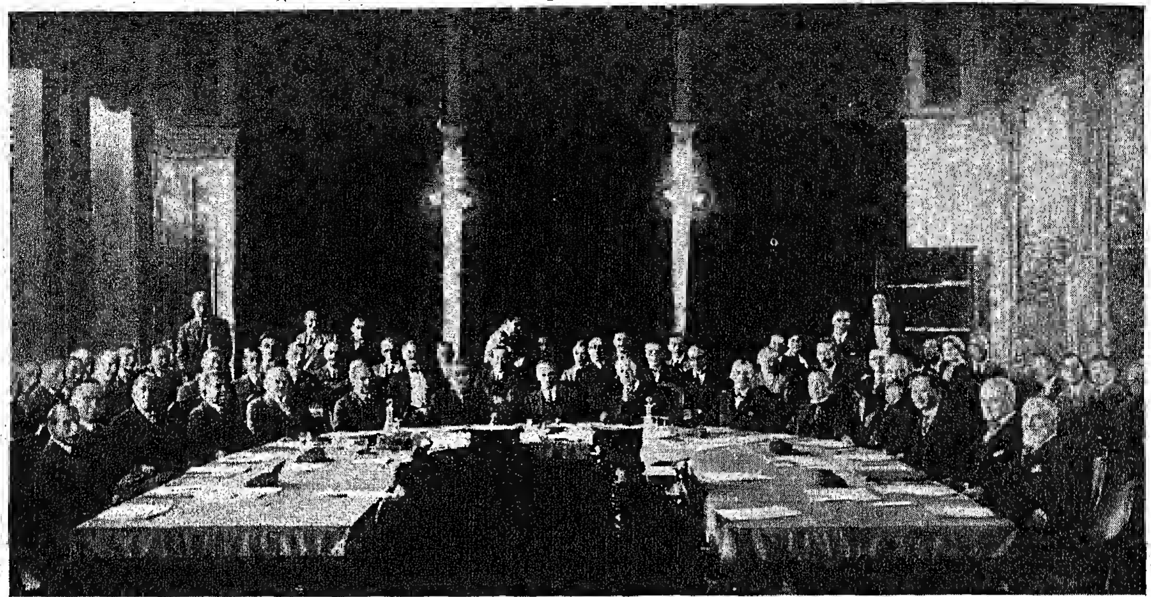
The first task relating to reparations was settling the amount, which was left open by the Treaty of Versailles. On July 16, 1920, at Spa, six of the countries entitled to reparations payments from Germany agreed among themselves upon their percentage shares of these payments. France was to receive 52 per cent, the British Empire 22 per cent, Italy 10 per cent, Belgium 8 per cent, Japan and Portugal $1\frac{1}{2}$ per cent; the rest was for Yugoslavia, Greece, and Rumania. Later these proportions were slightly changed.

Fixing the Reparations Payments

Next came the fixing of the total amount of German reparations payments. On April 27, 1921, this amount was fixed by the Reparation Commission at 132 billion gold marks, or about $31\frac{1}{2}$ billion dollars. Even at that time, many students of the situation felt that Germany would never be able to pay such a sum.

Near the end of 1922 Germany fell behind in her reparations deliveries of coal, either through inability or unwillingness to keep up to schedule. On December 26 she was judged in default by the Reparation Commission. In January 1923 France and Belgium occupied the Ruhr coal and iron district on the right bank of the Rhine, under authority of the Treaty of Versailles, both to enforce payment by Germany and to seize property in satisfaction of reparation obligations. This was the most highly industrialized area in

WHEN GERMANY JOINED THE LEAGUE



This is the first meeting of the Council of the League of Nations which Germany attended as a member. Of the two men who did most to bring this about, Gustav Stresemann of Germany is fifth from the left at the horseshoe table, and Aristide Briand of France is near the center, in line with the left-hand pillar in the background, as you view the picture.

Germany and its seizure totally demoralized the economic life of the nation. Immediately all reparations payments ceased, for Germany denied the justice of the French action, and the situation took the form of a stalemate. The paper mark became utterly worthless, and a large section of the German public was financially ruined. The occupation was highly unpopular in Great Britain and marked a widening of the breach between France and England in their foreign policies. Great Britain favored a policy of friendship with Germany and was eager to have reparations fixed at a definite and reasonable sum. The United States and Italy took a similar attitude. Belgium backed France.

The Dawes and Young Plans

Towards the close of 1923 the Reparation Commission, acting upon British and American suggestions, created two committees of experts, one to reëxamine the ability of Germany to pay and to make suggestions for the balancing of the German budget and stabilizing of the currency; the other to investigate the question of capital exported from Germany to avoid reparations payments. The first and principal committee was headed by an American, Gen. Charles G. Dawes, and the report submitted came to be known as the "Dawes Plan." The plan was accepted by the Reparation Commission and by Germany, and went into force on Sept. 1, 1924. French and Belgian troops then evacuated the Ruhr.

The Dawes Plan provided for payment of a billion gold marks the first year, increasing after four years to an annual payment of 2½ billion marks. A new Reichsbank and a new German currency were established. The annual payments were secured by certain tax revenues and liens against German railways and industrial establishments, and the whole system was placed under the supervision of an Agent General for Reparations Payments. This post was temporarily given to the American, Owen D. Young, and then to another American, Seymour Parker Gilbert.

At first German obligations under the Dawes Plan were met promptly. But by 1928 it became evident that further revision was necessary. Another expert committee, headed this time by Owen D. Young, worked out another report—known as the Young Plan—which went into effect on Sept. 1, 1929. The Young Plan called for 59 annuities of varying amounts, with a total present value reaching approximately 31 billion marks, or more than 7 billion dollars. All forms of coercion and control were removed, and the payment of reparations was to be made through a new international bank (*see* International Settlements, Bank for). The annual payments under the Young Plan were made a definite and fixed obligation of Germany, but Germany was granted the right, under specified conditions, to postpone two-thirds of each annuity for a period of not longer than two years.

The Interallied Debts

At the close of the war, the principal lending countries were the United States and Great Britain. It was evident, however, that in most cases the sums due were beyond the ability of the debtor countries to repay; so in the act of Feb. 9, 1922, establishing the Debt Funding Commission, and later acts, the United States announced its willingness to fund the debts and spread the payment of principal and interest over long terms of years. The funded debts under this arrangement then stood as follows: Belgium,

$417,780,000; Czechoslovakia, $115,000,000; France, $4,025,000,000; Great Britain, $4,600,000,000; Italy, $2,042,000,000; others, $480,000,000.

Despite the Young Plan, in 1931 Germany had reached a point where it was impossible to meet reparations payments (*see* Germany). President Hoover then proposed that Germany's creditors grant Germany a moratorium or delay of one year on all payments due them. To make this possible he offered, subject to confirmation by Congress, a moratorium on all debts due the United States by these same powers. After some difficult negotiations with France this moratorium, with some modifications, was adopted. In July 1932 representatives of Germany and her creditor nations, meeting at Lausanne, virtually agreed to end further reparations payments, scaling down the 7-billion-dollar total of the Young Plan to the equivalent of $714,000,000.

Germany's Financial Plight

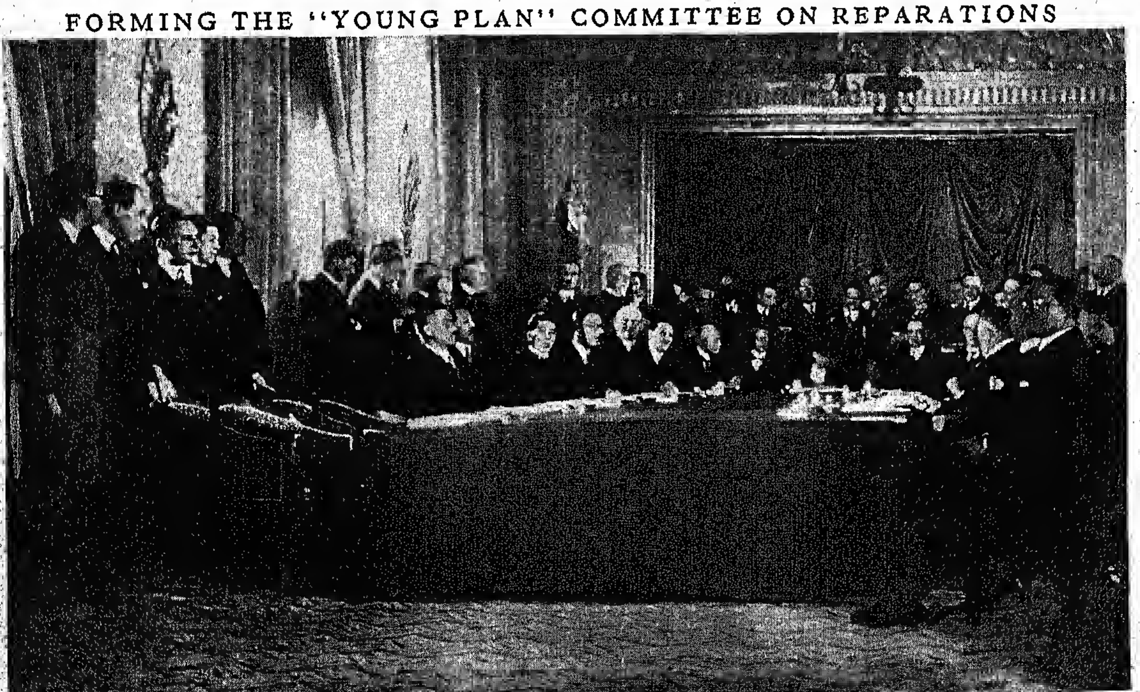
The continued and ever-increasing difficulty encountered by Germany in meeting her reparations obligations was produced by causes common in greater or less degree to the postwar economic situation in all the major belligerent countries. War expenditures, expenses of rebuilding lost or worn or damaged ships, factories, and railroads, expenses of new government services under the republic, all bore heavily upon German budgets, governmental and private. Billions of dollars were borrowed abroad (chiefly in the United States) by German governments, central and local, and by German business concerns, and interest charges mounted accordingly. Furthermore, Germany had lost markets overseas and in Europe, as a result of competition and tariff barriers, and was thus prevented from building up foreign credits with which to pay its debts.

This situation prevailed also, though to a lesser degree, in the rest of Europe. After Germany stopped making reparations payments in 1932, most European nations defaulted on their debts to the United States. One notable exception was Finland, which paid its instalments regularly. After the Russo-Finnish War of 1939–40, the United States rewarded this nation by granting it a ten-year moratorium.

International Relations

For a few years diplomatic relations among the nations of Europe seemed to run more smoothly. Russia gained trade agreements and, later, recognition and resumption of diplomatic relations with most of Europe and with the United States. For a time Germany's relations with the victorious powers also improved. Although there remained many sore spots on the map of Europe and many pressing problems were unsolved by the peace treaties, willingness to proceed in peace and friendship seemed to prevail during the years 1925–1930. Yet one feature of these years was the building up of a network of alliances which crisscrossed Europe and which were not in accord with the aims of the League of Nations or the international conferences. Thus France renewed alliances with Poland and the countries of the Little Entente (Czechoslovakia, Rumania, Yugoslavia) as protection against

FORMING THE "YOUNG PLAN" COMMITTEE ON REPARATIONS



This view shows the session of delegates which elected Owen D. Young of the United States chairman of the committee formed to fix the total amount of reparations due from the defeated countries to the victorious ones. This meeting was held in one of the hotels in Paris, in the elaborate surroundings which are a normal part of European diplomacy.

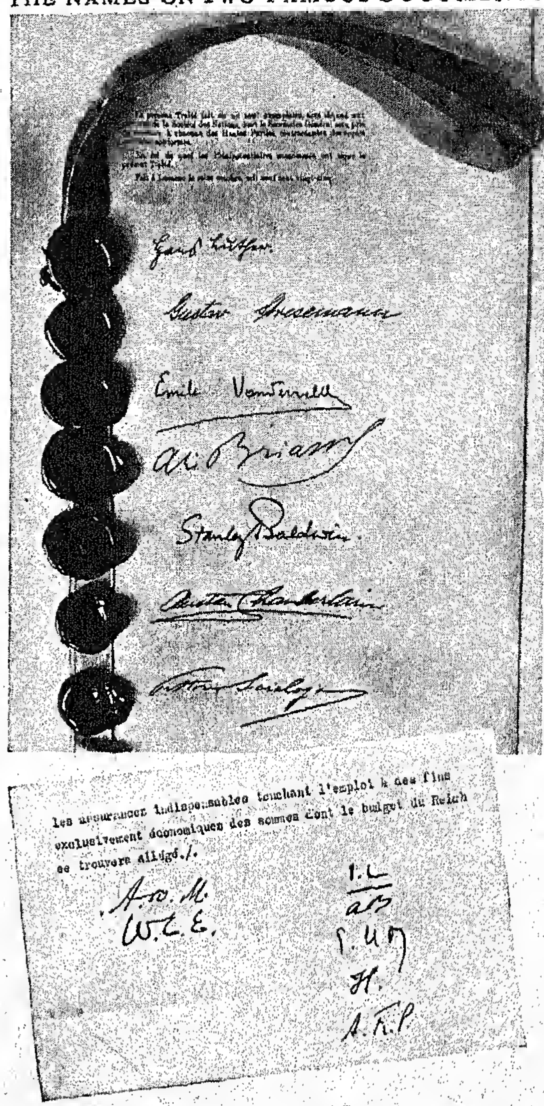
possible danger from Germany, Austria, Hungary, and Russia. League guarantees of territorial security were felt to be unreliable, and it was not until the Anglo-Italian guarantee of the mutual non-aggression pact concluded by France and Germany at Locarno in October 1925 that relief was felt in this direction. Even then, and even with the signing of the Briand-Kellogg Peace Pact Aug. 27, 1928, peace seemed insecure and disarmament still dangerous and far distant. Minority groups were protected to a considerable degree by the League against oppression at the hands of their new sovereigns (Germans in Poland and Hungarians in Rumania, for example). The occupied territories on the left bank of the Rhine were evacuated by the French, Belgians, and British in 1929–30, when the Young Plan regarding reparations went into effect, but cordiality and confidence were still lacking.

The War-Guilt Question

Two intimately related questions continued to vex the nations: war guilt and revision of the peace treaties. France and her allies in central Europe, Czechoslovakia, Rumania, Yugoslavia, and Poland, steadfastly opposed any change in the treaties. Germany, Austria, Hungary, and Bulgaria agitated for revision, especially of clauses which declared them responsible for starting the war.

Demands for revision of several territorial settlements were constant and bitter, centering upon the arrangements made for Upper Silesia, Danzig and the Polish Corridor, Transylvania, and the Tyrol. Germany urged its right to Upper Silesia, Danzig, and the Corridor; Hungary felt that Rumania had been given too much of Transylvania; and Austria bemoaned the Tyrolean Austrians lost to Italy. Italy generally befriended the "revisionists," but in 1931 backed France in preventing a proposed customs union between Germany and Austria.

THE NAMES ON TWO FAMOUS DOCUMENTS



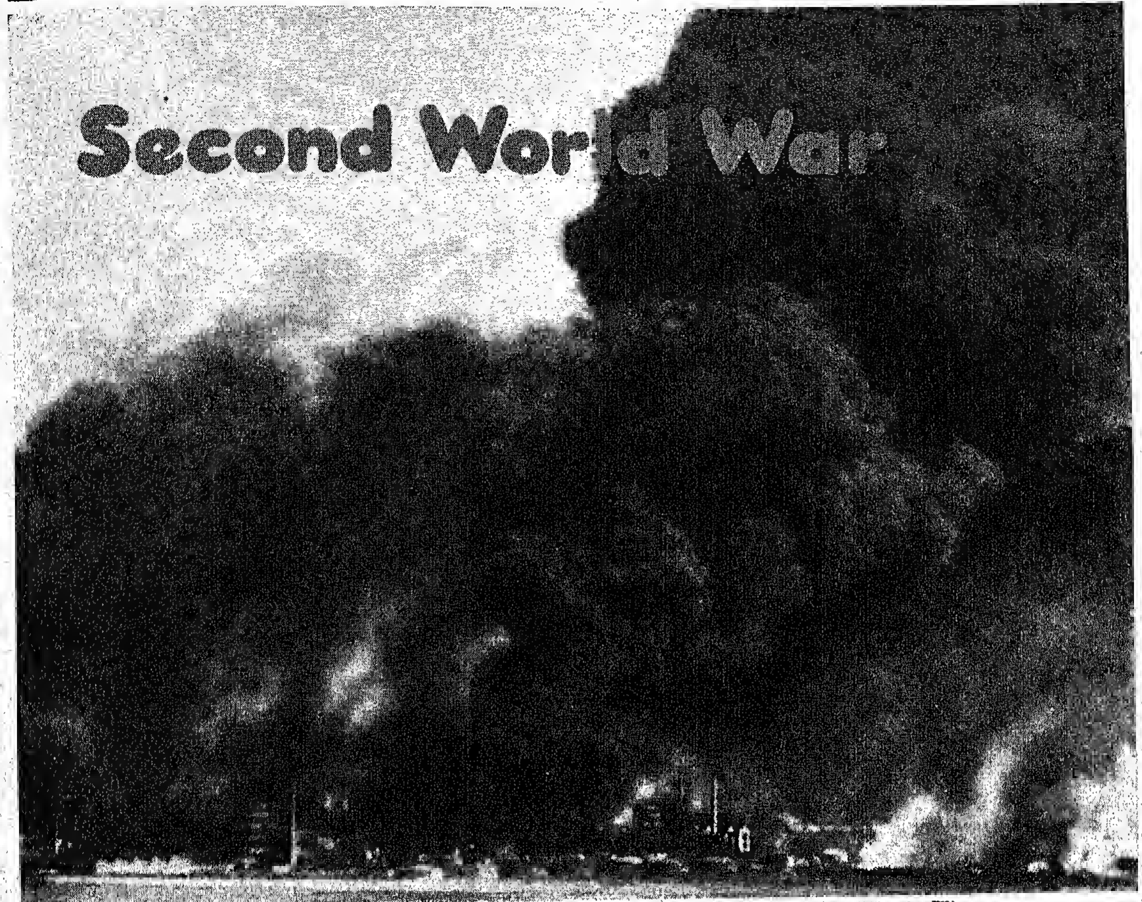
Above are the signatures to the formal Treaty of Locarno, complete with seals and ribbons. Below are the initials which gave effect to the Hoover moratorium, as between France and the United States. The men represented are Andrew Mellon, Walter Edge, Pierre Laval, Aristide Briand, P. E. Flandin, F. Pietri, and A. F. Poncet. Such initialed memoranda usually mark the agreement, sealed formal treaties being signed later.

Thus for more than ten years Europe failed to find real peace and a chance to rebuild prosperity. Then, economic depression set in; and as it progressed, more and more of the treaty arrangements broke down.

The territorial arrangements concerning Turkey, Poland, and Fiume already had been modified; and in January 1935, the people of the Saar, in a plebiscite which had been provided for in the peace treaty, voted overwhelmingly for return to Germany. The treaty provisions for reparations had been modified step by step. The Allied nations still retained mandates over former German colonies; but occupation of the Rhineland by Allied troops had ceased. The only unchanged portions of the Versailles Treaty dealt with certain territorial arrangements, and with restrictions upon Germany's military power. When Hitler became the head of the German government in 1933, he announced his intention to put an end to these restrictions but at first he took no action openly. After the Saar plebiscite showed his popular support, he at once repudiated every military limitation in the treaty. And in March 1936, he reoccupied the Rhineland with German troops, and began demanding the return of former German colonies. The Allied nations, weakened by the depression and fearing to provoke another war, could only protest and try to meet the German challenge by increasing their own armaments.

It soon became clear that another war was in the making. Italy, allying itself with Germany, seized Ethiopia and Albania. Germany took Austria and Czechoslovakia. To these acts France and England offered no military resistance, but when Hitler's troops invaded Poland Sept. 1, 1939, they declared war on Germany. (For a detailed account of the new war, *see* World War, Second.)

Second World War



Flaming Dunkirk Symbolizes the Terror and Destruction of the Greatest War in History

WORLD WAR, SECOND. The war that broke out in 1939, when Germany invaded Poland, was almost immediately recognized as a "World War." Its issues reached far beyond the boundaries and interests of the countries where the fighting began. Europe was the major theater of conflict, but the war rapidly spread its shadow over other continents.

It raged in the deserts and jungles of Africa. It drew into battle the young men of Australia, New Zealand, and Canada. In Asia, the fighting soon spread to Syria, Iraq, and Iran. The war between Japan and China, in progress since 1937, fell into place as part of the larger struggle.

Finally in December 1941, when Japan struck for domination of the entire Pacific, the United States was drawn in, and with it other nations of the Western Hemisphere. When that happened, the military and naval might of almost every nation in the world was arrayed on one side or the other.

How One War Led to Another

THE FIRST WORLD WAR left an enormous legacy of problems pressing for solution. These problems, and the efforts of the nations to solve them, are discussed in the articles on Europe and on the first World War (under the heading "The Peace and Its Results"). Empires had fallen and new nations had been created. The economic system of Europe was in a state of collapse. There were huge debts and appalling damage. Political upheavals and revolutions swept the continent. Everywhere arose the cry that out of the ruins must rise a new Europe.

But the Europe created by the Treaty of Versailles in 1919 was not new. On a map it looked different: many frontiers had been changed. Statesmen said it was different: they pointed to the League of Nations. But the tragic fact was that the ink on the treaty had not dried before the rulers of Europe resumed the same intrigues and secret maneuvers that had characterized European "power politics" for centuries.

Even the form adopted by the age-old struggle for power was not new. It was, simply, the relationship of the victor to the vanquished. The Versailles Treaty had imposed on Germany terms which President Wilson, one of the authors of the treaty, called "severe." To enforce those terms—to remove forever the threat of German power—became the major object of Allied diplomacy in the postwar years.

But at the very outset there were forces which challenged Anglo-French rule in Europe. In Russia the

war had given birth to a new Soviet system, whose aim was to establish communism at home and throughout the world. In Italy, in 1922, an ex-socialist named Benito Mussolini came to power and set up a government based on principles which he called fascism. In the Balkans, in central Europe, and along the Baltic, nations fell under the rule of dictators.

Despite these alarming signs of change, the Allies by their overwhelming military and economic supremacy were for a time able to enforce their will. France encircled Germany with a system of alliances in the east. The Allies dominated the League and frequently used it as the implement of their power. There were efforts at disarmament, but no thorough and effective limitations of arms resulted from them.

Though it did not rest on any very stable foundation, a victors' peace prevailed for a period, notably from 1924 to 1929. Then depression—a depression which had been in the making since the end of the war—burst upon the world. The depression came ten years after the Treaty of Versailles and ten years before the outbreak of the second World War. It marked, in a very real sense, the end of the "postwar" period and the beginning of the new "prewar" period. For if the war and its aftermath produced the depression, the depression in turn was to set in motion forces which would eventually plunge the world into a new and greater conflict.

The Period of Aggression

TO THE UNREST of the 1920's, the economic depression added appalling misery. Everywhere poverty crystallized opposition to the existing order. The crisis gave new support to systems of government opposed to democracy and to the ideals of international relations symbolized by the League of Nations. One such form of government was the totalitarian state, in which the nation is regimented by a dictator at home for the purpose of expansion abroad. (*See* Dictatorship; Fascism.)

It was natural that the totalitarian idea should take root in the nations that regarded themselves as having an unduly small share of the world's wealth and territory. These were the "have-not" nations, Germany, Italy, and Japan. Their opponents were the democracies, or the "haves." The 1930's were dominated by the struggle between these rival groups of powers. Beginning in 1931, when Japan invaded Manchuria, and accelerating after 1933, when Hitler came to power in Germany, the totalitarian states pursued a program of aggression whose ultimate aim was world domination.

'Mein Kampf' States Hitler's Intentions

The path of aggression was charted by Hitler in his book 'Mein Kampf'. There he stated these broad objectives: (1) renunciation of the Versailles Treaty, with its "intolerable" accusation of German guilt for the first World War; (2) restoration of his country's military power; (3) acquisition of new territories, especially those with large numbers of German-speaking people, as "living space" (*Lebensraum*) for Germany's crowded population; (4) establishment of the Germans as the "master race" on the European continent.

To accomplish this last objective, Hitler foresaw the necessity of annihilating Germany's "mortal enemy," France. In this he counted on Great Britain and Italy as allies, for he believed it was in the interest of all three to wipe out French domination of the continent. Once he freed his country of the danger of attack in the west, Hitler proposed then to pursue his major purpose—a drive to the east (*Drang nach Osten*) against Russia, whose broad rich expanse would provide unlimited opportunities for the industrious Germans.

Actions of the Aggressors

Except for his failure to win Great Britain as an ally, Hitler after his rise to power was able to follow closely the pattern laid down in 'Mein Kampf'. At first the totalitarian states pursued independently their programs of expansion. Japan consolidated its gains in Manchuria; Italy in 1935 invaded Ethiopia; and Germany in 1936 reoccupied the Rhineland. But mutual interests inevitably drew the aggressor nations together.

The first opportunity for joint action came when civil war broke out in Spain in July 1936. Germany and Italy aided the fascist rebels with arms, technicians, and troops. Their aid was given on the ground that the rebels were fighting a communistic régime supported by Soviet Russia. To implement this policy of opposition to the Soviet Union, Germany and Italy formed the Rome-Berlin Axis. Japan, which feared both Russia and the democracies, was drawn into the alliance through the anti-Comintern pact.

This formidable coalition was then in a position to pursue an even bolder policy of aggression. In 1937 Japan invaded China. Germany in March 1938 sent troops into Austria. The occupation of Austria was hardly completed when Hitler opened a campaign for the German-speaking portions of Czechoslovakia. In September, at a conference at Munich, he gained the consent of Great Britain and France to the surrender of the Sudeten regions; and six months later, in defiance of a British and French guaranty, he seized most of the remainder of the country. The same month, March 1939, the Spanish republic finally collapsed under the continued assault of the Axis-supported rebels. And the following month, while attention was diverted elsewhere, Italy annexed Albania.

Policies of the Anti-Fascist Nations

What enabled the totalitarian states to carry out this incredible program of aggression? How could Hitler plainly set forth a plan for the conquest of Europe and then methodically proceed, without effective opposition, to put the plan into action? What was the rest of the world doing?

During the period of aggression, from 1931 to 1939, three factors were decisive in shaping the policies of England and France: (1) these nations were weakened by internal dissension; (2) their peoples, ani-

mated by a profound desire for peace, had insisted on general reduction in armaments; and (3) they hoped to turn the tide of aggression eastward, against Soviet Russia. Upon all these factors Hitler played with Machiavellian skill. Alternating threats of war with promises of peaceful intentions, vowing always that his real enemy was Russia, he induced the democracies to stand aside.

SEEKING PEACE BY "APPEASEMENT"

At Munich on Sept. 29, 1938, gathered (from left to right) Prime Minister Chamberlain of Great Britain, Premier Daladier of France, Chancellor Hitler of Germany, and Premier Mussolini of Italy. Submitting to threats of war, the Allied leaders agreed to let Hitler cut up Czechoslovakia—his "last territorial demand in Europe."

Soviet Russia, against which the fascist coalition had presumably been formed, tried to draw England, France, and other peaceful nations into a plan to stop aggression. It vigorously supported the system of "collective security," under which all nations, through the League, would guarantee the independence of each. In 1935, to reinforce this policy, it formed mutual assistance pacts with France and Czechoslovakia. But this system of alliances broke down at the Munich conference of 1938, when Russia was excluded from negotiations in which France permitted Germany to dismember Czechoslovakia.

The United States protested the actions of Germany, Italy, and Japan, and as early as 1937 President Franklin D. Roosevelt advocated a policy of "quarantining" the aggressor, but this policy found little support. In southeastern Europe, in the Baltic and Scandinavian states, in Latin America—in fact, over most of the world—totalitarian aggression aroused indignation and fear; but the failure of England and France to provide leadership prevented the formation of a strong antifascist alliance.

Abandonment of "Appeasement"

The end of the British and French policy of "appeasement"—that is, of making concessions to the dictators—came after Germany's partition of Czechoslovakia in March 1939. Hitler's flagrant violation of his own pledge and his contemptuous defiance of the democracies finally united Great Britain and France in their determination to stop aggression.

Therefore Prime Minister Chamberlain of Great Britain and Premier Daladier of France (*see* Chamberlain, Arthur Neville; France) promptly pledged aid to Poland in case of Nazi attack; and in April they extended similar guaranties to Greece, Rumania, and Turkey. In defiance of the Anglo-French pledge to Poland, Hitler demanded the return of Danzig to the Reich and the cession of a strip of territory linking East Prussia with the rest of Germany. Poland immediately rejected these demands. Chamberlain warned that the attempt to annex Danzig or any part of Polish territory by force would meet with the armed resistance of Great Britain.

The Soviet-German Pact

Faced with an immediate threat of war, England and France on one side and Germany on the other began a diplomatic struggle to win the support of other nations in Europe. In May Germany converted the Rome-Berlin Axis into a formal military alliance with Italy, whereby each nation was pledged to support the other in war. England and France meanwhile conducted negotiations for a pact with Russia. But they did not pursue the negotiations with vigor, partly because of their reluctance to form a tie with Russia and partly also because Poland refused to let Soviet troops cross Polish soil in the event of war.

Hitler, on the other hand, was willing temporarily to renounce his bitter and contemptuous opposition to the Soviet system in order to avoid fighting a major war on two fronts. For, in the opinion of German military leaders, victory in the west required that Germany should not have to fight Russia in the east at the same time. Russia, in turn, feared that the failure of its negotiations with the democracies would place it in an isolated position. So the ground was laid for one of the most astonishing reversals in modern diplomatic history. On August 24, 1939, Germany and Russia signed a 10-year nonaggression pact which provided that neither nation would "associate itself with any other grouping of powers directly or indirectly aimed at the other."

Diplomacy Fails to Avert Conflict

The following day England converted its verbal pledge to Poland into a written military alliance. At the same time Chamberlain sought to bring about direct negotiations between Poland and Germany for settlement of their dispute. On August 29 Hitler agreed, on condition that Poland within the next 24 hours should send an emissary to Berlin with authority to conclude a settlement. When Britain protested against the haste and unfairness of this proposal, Germany replied on August 31 by making public its terms for settlement of the Polish dispute. These included the immediate return of Danzig to Germany and a vote (plebiscite) by the inhabitants of the Polish Corridor to determine whether the corridor should remain Polish or go to Germany. When the Polish ambassador to Berlin attempted to transmit these proposals to his government, he was unable to do so because the lines of communication had been cut.

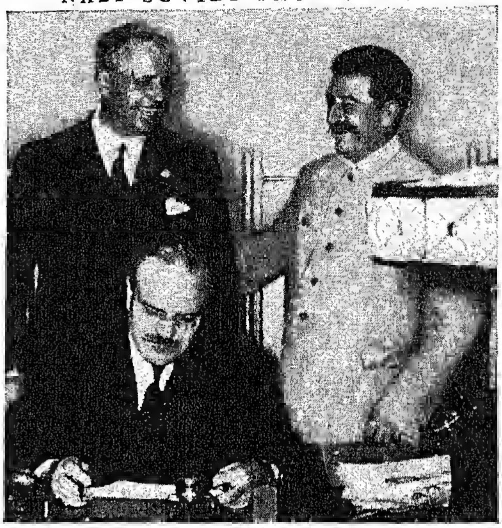
The next morning, September 1, Germany annexed Danzig and invaded Poland. On September 3 England and France sent ultimatums to Germany demanding the immediate withdrawal of German troops from Poland. When Germany refused, England (at 11:00 a.m.) and France (at 5:00 p.m.) declared war. Within a week Great Britain was joined in war by its dominions of Canada, Australia, New Zealand, and South Africa, and by India. The only portion of the British Commonwealth to remain outside the conflict was Ireland (Eire).

The Winter of 1939–40

THE OUTSTANDING military feature of the new world conflict was Germany's method of "total war." This is war waged with the sum total of a nation's resources. Though the concept was not new, the thoroughness with which the Nazis carried it out revolutionized modern warfare. As practised by them, total war involves every man, woman, and child, and every product of farm, field, and factory in the war effort. This all-encompassing organization of the "home front" behind the fighting forces is made easier by the totalitarian form of government, which even in peacetime regiments all the nation's resources, man power, and energies.

The favorite military tactic of total war is *Blitzkrieg*, or "lightning war"—a combination of crushing bombardment from the air with swift invasion by highly mechanized units on land. *Blitzkrieg* requires favorable terrain and weather, perfect timing, a high degree of training and organization, and, above all, superiority over the enemy in arms and equipment. The offensive is sudden and ferocious. Successfully executed, it demoralizes the defenders before they can comprehend the plan of attack and organize to meet it; and so it leads to quick surrender.

NAZI-SOVIET PACT OF 1939



Soviet Foreign Commissar Molotoff signs a pact of non-aggression between Germany and Russia, as German Foreign Minister Ribbentrop and Stalin look on smilingly.

It was *Blitzkrieg* in all its incredible fury that the Germans launched against Poland on Sept. 1, 1939. Relying on its strong western fortifications to hold off an allied attack, Germany flung the full weight of its military machine against the Poles in an effort to eliminate this eastern front.

Campaign in Poland

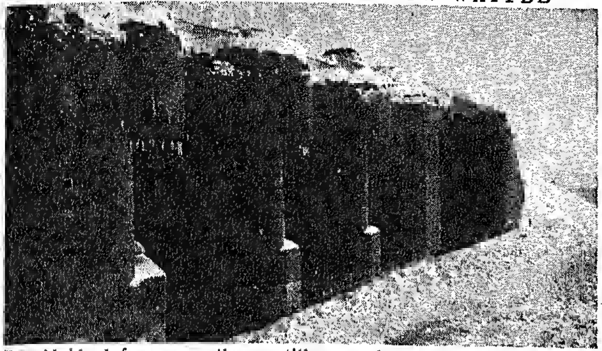
The Poles, cut off from their allies in the west, outnumbered, outmaneuvered, and engulfed even before they were well mobilized, fell easy victims to the German invaders. The first day German aviation destroyed Poland's flying fields and bases, and within a week it had crippled lines of communication. Simultaneously, German *Panzer* (motorized and mechanized) divisions, by a series of encircling movements, enveloped Polish armies in the northwest and southwest. The Germans then converged on the main Polish forces pocketed in the region around Warsaw. Retreat turned into a disorganized rout on September 17, when Russia sent its armies across Poland's eastern frontiers. The besieged people of Warsaw continued to maintain a desperate, gallant resistance, but furious pounding by artillery and aviation finally forced them to surrender on September 27. Two days later Germany and Russia concluded a treaty in Moscow dividing Poland between them.

The Russo-German partition, the fourth in Poland's history, divided the country by a line running roughly along the Bug and San rivers. The western part occupied by Germany contained about 45 per cent of the area, 60 per cent of the population, and the richest

POLISH ARTILLERY—BEFORE AND AFTER "BLITZKRIEG"

Polish troops and their outdated horse-drawn equipment are moving west—to be crushed by Hitler's mechanized armies. Wrecked Polish batteries like those at the right strewed the roads and fields. Fighting with arms that dated largely from the first World War, and confused and disrupted by poor leadership, the Poles were hardly a match for the Germans.

BEHIND THESE THE FRENCH WAITED



Formidable defenses are these artillery emplacements on the Maginot line. Believing themselves securely protected by their fortifications, the French marked time during the winter of 1939–40. Germany meanwhile prepared its fatal spring offensive, which was to take the Maginot line from the rear.

farm and industrial regions. Russia took the remainder, mostly agricultural and forest land. In October Hitler formally annexed the provinces of Pomorze, Posen, and Upper Silesia to the Reich; and he appointed a Nazi governor general to rule the rest of German Poland, including Warsaw. Continuing the struggle against Germany with the Allies were the Polish government officials, soldiers, airmen, and naval units that managed to escape the swift Nazi advance. (*See also* Danzig; Poland.)

Stalemate in the West

In contrast to Germany's new methods and strategy of warfare, as demonstrated in the Polish campaign, England and France were committed to almost exactly the same military plan they had used in the World War of 1914–18. The cornerstone of this plan was the blockade of Germany by the Allied fleet. The blockade was expected to reduce Germany to utter privation and thus compel the Nazis to launch a disastrous offensive against the French army and fortifications, which the Allies believed were impregnable. These Maginot fortifications consisted of a series of underground forts, machine-gun nests, and tank traps extending along the German frontier and stretching with a thinner zone of fortifications along the Belgian border to the North Sea. Entrenched behind these massive defenses, the Allies complacently settled down for a long war in which their superior resources, they thought, would eventually vanquish Germany.

The Germans with equal confidence relied for defense on their Siegfried line, similar to the Maginot line in construction and paralleling its position. But to them inactivity on the western front during the winter of 1939–40 provided a welcome opportunity to replenish their military forces after the campaign in Poland. A further reason for their inaction during this period was the unsuitability of winter weather for *Blitzkrieg*, which requires clear skies for planes and dry ground for tanks and other motorized units.

Thus, for reasons based on their respective strategies, both sides failed to launch any large-scale offensive in the west during the first winter of the war. Clashes between small patrols were the only events in the No Man's Land between French and German lines. Planes did little but take photographs and drop propaganda leaflets over enemy territory. An ominous quiet prevailed.

War Organization and Propaganda

With their vast forces immobilized behind defensive lines, each side girded itself for the struggle ahead. The governments of England and France took control of every aspect of the national life, regimenting communication, transportation, and industry almost as strictly as was done in the totalitarian states. The military and diplomatic alliance between the two nations was extended to far-reaching coöperation in economics and finance. They pooled their merchant marine, coördinated their production and import programs, and agreed to share the expenses of the war on a 60–40 basis, with England bearing the larger share. Their joint military activities were governed by a Supreme War Council, which placed naval forces of the two nations under the command of the British and land forces under the French. The French general, Maurice Gamelin, was made Allied commander in chief.

In Germany the transition to a complete war footing was swiftly accomplished. The most significant domestic event was Hitler's pronouncement that should he die, Marshal Hermann Goering, minister of aviation, would succeed him, and that the next in succession would be Rudolph Hess, National Socialist leader.

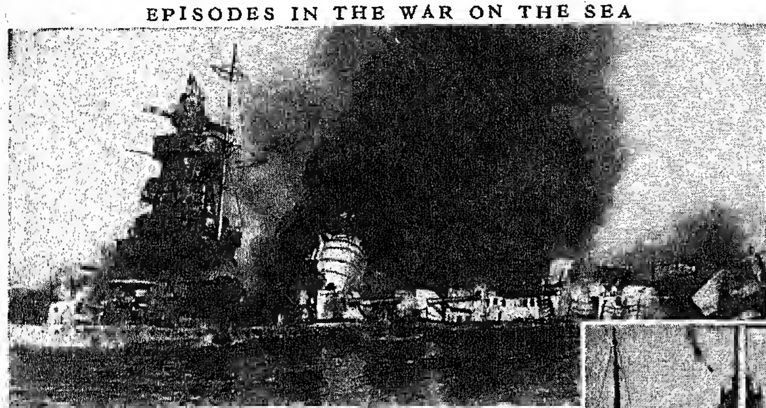
From the beginning each side conducted an intensive propaganda campaign. With the frightful experiences of the last war and its aftermath still vivid in their minds, many people had come to believe that war in any form was folly. So the governments of the bellig-

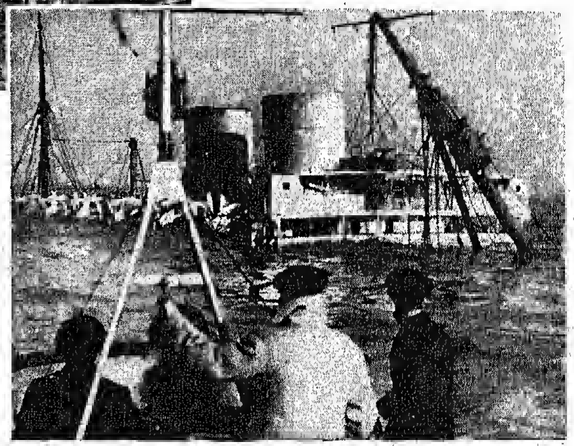
PASSED BY THE CENSOR

Letters by British soldiers in France are being read by the censor to guard against revelation of military secrets. Radio broadcasts, news films, and press dispatches were also placed under rigid censorship in all the warring countries.

erent nations, to strengthen morale at home and to win support abroad, sought again and again to justify participation in another conflict. Hitler asserted that he did not start the war, that he had no quarrel with England and France, but that, if driven to it, Germany would annihilate its enemies. In October he proposed that if England and France would accept the partition of Poland, he was willing to conclude peace. The Allies rejected his offer and announced their determination to fight until Germany was defeated. To critics who asked for a definite statement of "war aims," they replied that the first all-important task was to overthrow the Nazis, and that then free men could discuss the kind of world they wanted.

EPISODES IN THE WAR ON THE SEA





Scuttled by her captain to avert capture by the British, the German battleship *Admiral Graf Spee* (above) sinks, a flaming hulk, off Montevideo. At the right a British vessel, *Dunbar Castle*, hit by a mine, goes down off the coast of England. Mine sweepers later reduced this serious threat to British shipping.

War on the Sea

In contrast to the early stalemate of land warfare in the west, the war on the sea was exceedingly active. Great Britain and France used their tremendous naval power to prevent Germany from receiving war materials, food, and other vital supplies. They later extended the blockade to include Germany's exports as well, and they rationed supplies to neutral countries that were in a position to reship to Germany.

Germany in turn launched a counterblockade, and its submarines, mines, and depth bombs took a heavy toll of Allied merchant and passenger vessels. Nevertheless, Great Britain and France retained control of the major sea lanes; and neutral and Allied ships, convoyed by destroyers and planes, brought them a steady flow of supplies. (*See* Blockade.)

Despite the clash of blockade and counterblockade, there was at first no large-scale test of strength between the Allied and German fleets, such as occurred in 1916 in the Battle of Jutland. Naval warfare nevertheless produced many spectacular exploits. In December 1939 a dramatic sea battle took place off the coast of South America. Three British cruisers damaged the German raider *Admiral Graf Spee*, forced it to take cover in the harbor of Montevideo, and, by trapping it there, compelled its captain to sink the ship rather than risk capture. Another daring British naval venture was undertaken in February 1940. The British destroyer *Cossack*, invading Norwegian territorial waters at Josing Fiord, rescued 300 British seamen who had been captured during the *Graf Spee*'s raids and who were aboard its consort, the *Altmark*.

Of the German naval victories, the most sensational was a raid in Scapa Flow. On October 14, a German U-boat penetrated this British naval base and torpedoed the battleship *Royal Oak*, which went down with 786 of its crew.

Policies of Nonbelligerent Nations

Among the nations not involved in the conflict at its outbreak, there were efforts to preserve neutrality and, if possible, to bring about a peace before the commencement of large-scale hostilities. King Leopold of the Belgians, Queen Wilhelmina of the Netherlands, and President Roosevelt, as well as Pope Pius XII, attempted unsuccessfully to intervene for peace.

Despite diplomatic pressure by the belligerents, few nations at first openly took sides. As in the first World War, Italy failed to carry out its pledge of immediate aid to Germany at the outbreak of hostilities. Mussolini nevertheless asserted that his country was a "nonbelligerent ally" of the Reich, and by his threatening attitude compelled France to divert part of its forces to the Italian frontier. Spain, Hungary, and Japan, also linked to Germany through the anti-Comintern pact, adopted a similar attitude of purely verbal support of the Nazis. Turkey, in May 1939, agreed to aid England and France against any power except Russia if war spread to the Mediterranean area. Most nations, however, awaited developments before making any decisive moves.

Russo-Finnish War and Soviet Expansion

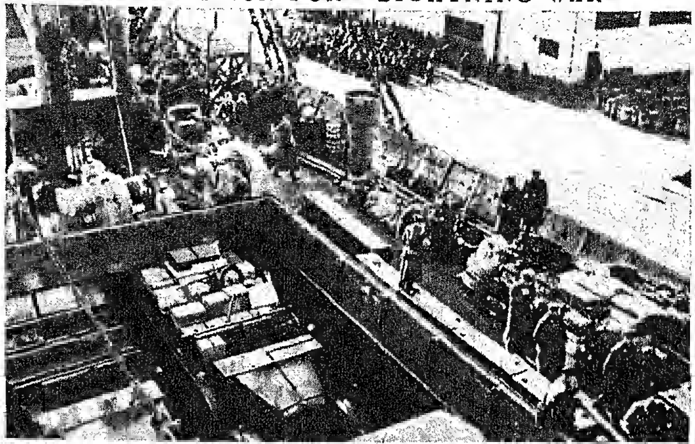
Of these nonbelligerent nations, the one which pursued the most enigmatic policy at this time was Soviet

Russia. It denounced both sides in the war as "imperialist" powers and announced that its aim was to strengthen itself against a possible attack by either of the belligerents. To this end, the Soviet Union in September and October 1939 compelled Esthonia, Latvia, and Lithuania to grant it military bases and far-reaching diplomatic concessions. But the attempt to impose similar terms upon Finland met with firm resistance; and so, on November 30, Russia invaded the country.

Though immense Soviet superiority in numbers was expected to overwhelm Finland in short order, the Finns surprised the world by putting up a sturdy fight. Aided by the intense cold, by their Mannerheim line of fortifications along the Karelian Isthmus, and by their familiarity with the rugged and broken terrain, they repulsed the invaders with heavy losses in the first few months. But persistent bombardment by planes and heavy artillery finally achieved a break-through of the Finnish defenses. On March 13, 1940, Finland signed a peace treaty which granted the Soviet Union an important slice of Finnish territory, including the Karelian Isthmus and the port of Viipuri (Viborg). (*See* Finland.)

Russia further strengthened its strategic position in June, when it compelled Rumania, under threat of invasion, to cede Bessarabia and northern Bukovina. Meanwhile it increased its penetration of the Baltic States. This culminated early in August when Lithuania, Latvia, and Esthonia voted, under pressure, to become new republics of the Soviet Union (*see* articles on those countries). Along its entire frontier with Germany and German-dominated territory, Russia now occupied new lands which would serve as a buffer in the event of a Nazi attack.

ORGANIZATION FOR "LIGHTNING WAR"



This Nazi transport invades a Norwegian port with its supply trucks loaded, ready to roll. Troops, already in formation on the wharf, await their marching orders. Not a minute lost nor a detail overlooked by the incredibly efficient Germans.

German Invasion of Denmark and Norway

As spring thawed the fields of Europe, the world nervously awaited the end of the winter lull. Where and when would Germany strike? Hitler chose Scandinavia, to attain several vital objectives. First, control of the coast of Norway as a springboard for an eventual attack upon Great Britain. Second, use of the Norwegian coast as a base of operations against the Allied blockade. Third, occupation of Denmark and Norway to safeguard Germany's supply of Swedish iron ore and to open up all the rich resources of Scandinavia.

Pretext for Germany's drive to the north came on April 8, 1940, when the Allies announced the laying of mine fields off the coast of Norway. Early the next morning Germany invaded Denmark and landed troops in Norway. Occupation of these countries for the duration of the war was necessary, the Nazis claimed, to forestall an Allied attack on Germany through Scandinavia.

HOW THE NAZIS CONQUERED THE STURDY NORWEGIANS

At the left we see the landing methods used by the Nazis when, in the early morning of April 9, 1940, they swarmed over the coasts of Denmark and Norway. The Danes, virtually defenseless, offered no resistance, but the Norwegians, aided by the British, fought hard and well. Even in defeat the Norwegian fighters surrendering their arms (at the right) seem unbroken in spirit.

Denmark, incapable of resisting, accepted the "protection" which Germany offered the two countries. Within a day it was occupied by the German army. King Christian X was retained as nominal ruler, but the country was governed in effect by the German army of occupation. Norway, however, instantly declared war, and it received a pledge of "full aid" from Great Britain and France.

Campaign in Norway

The first day of their invasion the Nazis seized Oslo, the capital, and most of the other important coastal cities of Norway. British naval and air forces promptly engaged Nazi troop transports, but, though they inflicted heavy losses, they were unable to prevent the Germans from bringing supplies and reinforcements to their coastal garrisons. On April 15 British expeditionary troops were landed in Namsos and Aandalsnes, to reinforce the disorganized Norwegian forces. But they were unable to stem the swift advance of German columns moving north from Oslo; and when these columns established connection with the German base at Trondheim, the Allied defense in Norway was doomed. On May 2 and 3 the British forces were evacuated. They regained a foothold at Narvik, in the far northern part of the country, but this was abandoned finally on June 9. The same day King Haakon VII of Norway announced the surrender of his country to the invaders. He and his government fled to England, where they continued the struggle (*see* Norway).

In its conquest of Norway, Germany was greatly aided by the work of its "fifth column." The term included Germans living in the country and also Norwegian Nazis, under the leadership of Major Vidkun Quisling. These people assisted the invaders by issuing false military orders, by creating confusion and dissension among civilians, and by taking part in the "puppet" government through which Germany later ruled the country. One of the novel methods of German strategy in the war was the organization of such "fifth-column" groups in European and American countries to hamper their defense and force the adoption of pro-Nazi policies. The term was derived from the Spanish civil war of 1936–39, when the fascist general Mola, leading four columns of troops on the loyalist capital of Madrid, boasted that he had a "fifth column" of sympathizers within the enemy's gates. Another term applied to such traitors was "Quisling," from the name of the Norwegian Nazi.

GESTAPO AND "FIFTH COLUMN"

Heinrich Himmler, chief of the German secret police (Gestapo), gives the Nazi salute to leaders of the "fifth column" in Norway. The bareheaded man at Himmler's left is Quisling, head of the Norwegian Nazis.

Conquest of the Low Countries and France

WITH THE Norwegian campaign virtually concluded by the end of April, Germany was ready to launch the decisive offensive in the west. Its plan of attack was a variant of the strategy used in 1914—a plan based on the ideas of Gen. Alfred von Schlieffen, chief of the German general staff from 1891 to 1907. The "Schlieffen plan" called for a defensive left wing which would hold the French along the fortified Rhine frontier, while an irresistibly powerful right wing swept through the plains of Belgium and the Netherlands into northern France, and then circled southward and eastward to attack the French fortifications from the rear.

Hitler's innovation was to split the German right wing into two armies. One was to overrun Holland and northern Belgium, and to draw large Allied forces into the extreme north in the hope of stemming the German attack. Once the Allied force was in position there, the Germans planned a rapid central thrust by the second army from the Ardennes to the North Sea, cutting off these northern Allied troops. After destroying the forces trapped in Flanders, the Germans planned to launch the second major phase of their offensive—an overwhelming frontal attack which would quickly overpower the remainder of the French army.

Invasion of Holland, Belgium, and Luxemburg

Suddenly, before dawn on May 10, the great offensive began. The German army and air force invaded Belgium, the Netherlands, and Luxemburg. Again, as in the case of Norway, the Germans attacked the neutrals first and explained later; and again the explanation was that they were moving to forestall an Allied attack.

Luxemburg, tiny and defenseless, was occupied by the Germans without resistance within a day (*see* Luxemburg). Belgium and the Netherlands instantly declared war, and appealed to France and Great Britain for aid. Great Britain called Winston Churchill, dynamic first lord of the admiralty, to replace the aged Neville Chamberlain as prime minister (*see* Churchill, Winston). And the Allies instantly dispatched troops into the Low Countries, to try to stem the German advance.

The Battle of Flanders

This time the German *Blitzkrieg* opened with a startling novelty. Troops landed by parachute seized

strategic bridges and forts before the Dutch could carry out their plans for flooding the country or the Belgians could organize their main line of defense along the Albert Canal. As tanks and motorized units overran Holland's lowlands, planes mercilessly bombed Rotterdam and other Dutch cities. On May 14 the Dutch army, pushed back to the sea, was ordered by its commander to cease fighting. All Holland was quickly brought under the rule of German forces of occupation. Queen Wilhelmina, who had fled to London, formed an "exile government" there, which retained the allegiance of the Netherlands Indies and the rest of the rich Dutch empire. (*See also* Netherlands.)

In Belgium, a German mechanized column cut across the Albert Canal and thrust ahead toward Brussels, to merge with the forces pressing down from Holland. To the south, dive bombers and tanks broke Allied resistance along the Meuse at Sedan and Dinant, and through these gaps the Germans raced for the Channel. If the Allies had been prepared to pinch off these advanced troops, the German left flank thrust would have been suicidal. But the Germans reached the Channel at Abbeville on May 21, and hastily reinforced this line so that it held against belated and scattered French attacks from the south.

THE GERMANS ENTER PARIS

Hitler's army of conquest here parades triumphantly through the Arc de Triomphe, symbol of French military glory. Paris had been abandoned to the advancing Germans to prevent the city's destruction.

The British, French, and Belgian troops in Flanders were now caught in a pocket with German forces converging on them. King Leopold of Belgium, convinced that further resistance was futile, surrendered his army on May 28. The Allies then had no choice but to attempt an escape by sea. Mustering every available vessel and gaining temporary control in the air, the Allies, from May 29 to June 4, evacuated more than 300,000 men from Dunkirk in one of the most remarkable naval operations in history. (*See* Belgium; Dunkirk.)

FRANCE BOWS TO A GERMAN ARMISTICE

Wilhelm Keitel, commander of the German armed forces, stands to read the armistice terms to the French delegates. Hitler sits at Keitel's right.

Italy Enters the War

On May 19 General Gamelin had been replaced by Gen. Maxime Weygand as commander in chief of the Allied armies. Weygand attempted to organize a line of defense along the Somme and Aisne rivers, where the French might hold the advancing Germans. On June 5 the Battle of France began with a great German offensive along a front extending more than 100 miles from near Laon to the Channel. Throwing huge reserves into the battle, the Germans smashed through the weakened and disorganized French forces and headed for Paris.

At this juncture, on June 10, Italy declared war on Great Britain and France. Mussolini asserted that Italy was engaging in a crusade against the democracies, but it was evident that, with France nearing defeat, the dictator was only seeking a share of the spoils. Italian troops saw almost no action in the Battle of France.

Fall of France

On June 11 the French government moved to Tours and later to Bordeaux. Paris, which had been declared an "open city" by the French to spare it from destruction, was occupied by the Germans June 14. Meanwhile the Germans advanced almost without opposition through central France, taking the Maginot fortifications from the rear. There were desperate efforts to avert the imminent French collapse. Premier Paul Reynaud of France addressed an urgent appeal to President Roosevelt for "clouds of war planes" and for a public declaration of United States aid. Prime Minister Churchill attempted to bolster French morale by proposing an immediate economic and political union of Great Britain and France. But these efforts were of no avail, and on June 16 the French cabinet voted in favor of an armistice. Marshal Henri Pétain, the 84-year-old hero of the first World War, became premier, and that evening he petitioned the German government to state its terms.

The Franco-German armistice was signed June 22 in the forest of Compiègne, in the same railway car in which a victorious France had dictated its terms to a beaten Germany 22 years before. The armistice provided for German occupation, at French expense, of

more than half of France, including its entire Atlantic coast and all its northern area to a line extending from Geneva almost to Tours. The French were to demobilize and disarm all their armed forces, excepting only those necessary to maintain order at home and in their colonies. They also had to turn over all military supplies to Germany. The Franco-Italian armistice, concluded June 24, compelled France to demilitarize its frontier with Italy, its strategic colonial outposts in Africa, and certain naval bases in the Mediterranean. With the signing of the Italian armistice, the war in France formally ended. The armistice terms were to remain in effect until the conclusion of a peace treaty.

The astonishing ease with which French resistance had crumbled under German assault was attributed by most observers to a combination of military weakness and political decay. Confusion and dissension in every aspect of French national life for years before the war had paved the way for disaster when the crisis came. Behind the scenes in the republic powerful persons had stood ever ready to betray French democracy and to supplant it with a totalitarian form of government.

Establishment of "Vichy Régime"

The military collapse of France gave them their opportunity. In July the government of unoccupied France, from its headquarters at Vichy, voted out of existence the democratic French parliament. Upon the ruins of the Third Republic, Marshal Pétain built a fascist state in which he, as president and premier, held dictatorial power. As the war progressed, the Vichy government, under the influence of men like Admiral François Darlan and Pierre Laval, "collaborated" with Germany to the extent of rendering France a virtual Nazi puppet. Opposed to this course were the remnants of the French forces which had reunited in England to carry on the struggle against Germany under the leadership of the French general Charles de Gaulle. Though these "Free French" were bitterly assailed by the Vichy government, and their partisans in unoccupied France punished as "traitors," they won wide support from the French people, both at home and in the empire.

A major concern of Great Britain after the fall of France was to prevent the French fleet from falling into Germany's hands. Some French vessels joined the British, and some were interned in British harbors. One force which resisted was all but destroyed by the British fleet at Oran, Algeria. As a reprisal for this action, the French government broke off diplomatic relations with Great Britain, thus severing an alliance which for a generation had played a dominant rôle in European affairs.

LONDON ABLAZE FROM INCENDIARY BOMBS

Fires from bombs dropped by German planes light the sky over London. The Nazi raiders came by night after R.A.F. pursuit planes had made daylight raids too costly.

Battle of Britain and the Atlantic

HITLER evidently expected that the fall of France, with the consequent collapse of Allied power on the continent, would bring about a swift British capitulation. In July he urged Great Britain to conclude peace with Germany. Churchill rejected the proposal, and reaffirmed Britain's determi-

BLOW FOR BLOW IN THE WAR ON CIVILIANS

Londoners at upper left are clearing wreckage caused by German bombing planes. Others just below snatch some sleep in a subway station used as an air-raid shelter. The two pictures at the right show Berliners similarly occupied during a British raid.

nation to fight on "night and day, giving all, daring all, enduring all," until Hitlerism was defeated.

If the British people could resist an invasion and lightning conquest of their island, they relied on their superior resources ultimately to vanquish Germany. From the empire they received aid in man power and supplies. From the United States, whose policies are discussed later in this article, they received increasing material support. Their naval blockade of the continent intensified the difficulties of the Nazis in ruling the rebellious peoples of the occupied countries. Beyond all this, Britain was sustained by the hope that the aggressive policies and ruthless methods of the Nazis would eventually lead them to disaster.

At this point, therefore, the war pitted against each other a great continental land power, Germany, and an island sea power, Great Britain. Except for the additional factors introduced by the airplane, the struggle in broad outline had assumed a striking resemblance to the classic phase of the Napoleonic wars in which France ruled the continent and Britain ruled the seas. It remained to be seen whether air power would end the deadlock.

Aerial Campaign against England

At the outset of the war, Hitler had warned that "there are no longer any islands"—meaning that Britain's isolation from the continent was no protection from German bombing planes. His threat of a mass aerial offensive was finally carried out in mid-August of 1940. Almost daily, hundreds of German planes swarmed across the Channel from bases in occupied France and bombed England from end to end. Industrial cities such as Coventry, Birmingham, and Manchester, and ports such as Liverpool, Southampton, and Portsmouth were pounded unmercifully. London was raided night after night, with terrible damage to its historic buildings and monuments. Aerial bombs wounded and killed many civilians, and the entire population was subjected to terrific strain and hardship.

The German aerial offensive appeared to have two objectives, preliminary to an invasion of England—first, to gain control of the air over England; and, second, to break the morale of the British people. Neither objective was achieved. The Royal Air Force brought down the invading planes at a crippling rate and clearly demonstrated an ability to break up any German mass assault. The R.A.F. furthermore took the offensive, bombing Germany, Italy, and Axis-occupied territory, and particularly the "invasion ports" along the Channel coast. The British people, undismayed by German attacks, only increased their efforts to make England an "island fortress," which could repel any invasion attempt.

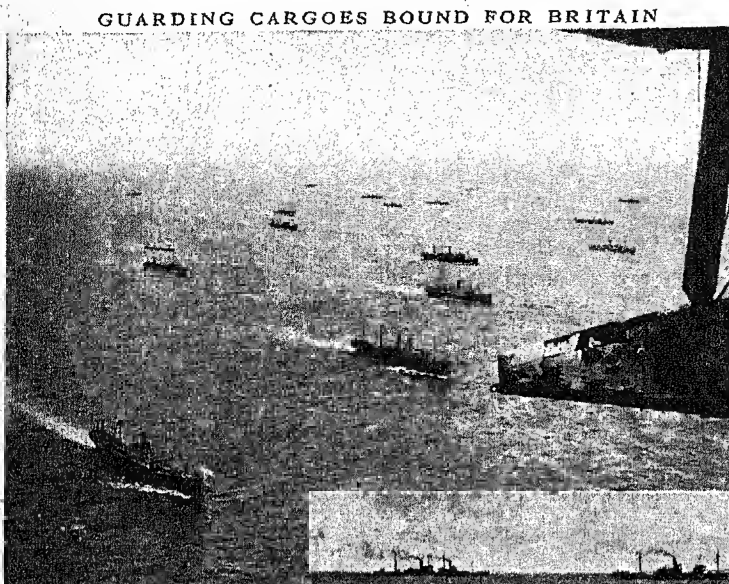
Campaign against British Shipping

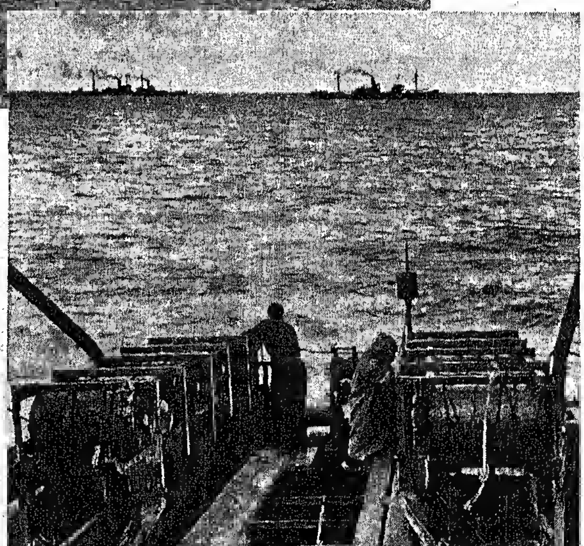
Along with its stepped-up aerial campaign against England, Germany intensified its efforts to establish

an effective blockade. The blockade struck at the heart of Britain's resistance—its control of the sea lanes to bring supplies from abroad. Britain is one of the least self-sufficient countries in the world; and the supplies which it imported from its empire and the United States were vital not only to prosecution of the war but to life itself. Germany's conquests had given it bases along the entire Atlantic coast of Europe from Bordeaux to northern Norway—nearer even than the British Isles to many of the most important British shipping lanes. Operating from these bases, German submarines and planes struck with deadly effectiveness at merchant shipping in the north Atlantic. Allied ships, with their precious cargoes of food, raw materials, planes, and munitions, were being sunk at a rate several times greater than the combined capacity of Great Britain and the United States to build new vessels.

Against the menace of German raiders, Britain convoyed its shipping with destroyers and planes. That these Atlantic patrols were not more effective was due in part to the fact that the British fleet was compelled to divert much of its strength to the Mediterranean. Another factor was that convoys, though they might ward off destroyers, were an easy target for planes. For victory in the "battle of the north Atlantic," Great Britain relied, in the final analysis, on American aid.

GUARDING CARGOES BOUND FOR BRITAIN





At the top, ships carrying American supplies to England are guarded by a British fighter plane, whose wing tip is just visible. Below, a British corvette is dropping a depth charge to blast out a submarine found lurking in the convoy's path.

The Far East in the War

DURING the comparative lull after the fall of France and the subsequent siege of Britain, new lands outside Europe gained the spotlight in the spreading conflict. Among the areas vitally affected by the extension of the war was the Far East.

Background of the Sino-Japanese Conflict

When the second World War broke out, Japan was in the third year of its struggle to conquer China. The aggression in China was part of Japan's long-range program of expansion in Asia. In domestic affairs, the imperialist program had brought Japan under the rule of a totalitarian dictatorship; in foreign policy, it had, as we have seen, lined up the country with the other aggressor nations. (*See* Japan.)

But the Chinese people, under the leadership of Gen. Chiang Kai-shek, defended fiercely their vast land and its new democracy (*see* Chiang Kai-shek). Aided by supplies and technical assistance from Soviet Russia, the United States, and Great Britain, they fought the invaders with incessant guerilla warfare that bogged down the Japanese armies in China and seriously endangered the war-minded ruling clique at home. (*See* China.)

Because of this, the Japanese sought gains elsewhere. The involvement of the western nations in war in Europe, and the withdrawal of much of their strength from the Far East, seemed a tempting opportunity. Remaining neutral in the war in the west, Japan undertook to spread its dominion throughout eastern Asia.

Japan in East Asia

Germany's conquest of the Netherlands and France, leaving relatively undefended the rich Netherlands Indies and French Indo-China, gave Japan its first great chance. It immediately asserted its interest in the Dutch colony; but its move was countered by the United States and Great Britain, which declared their intention of "maintaining the status quo." In French Indo-China, however, Japan, by threatening invasion, obtained in September 1940 air bases and garrisons for use against China. At the same time Japan

encouraged Thailand (Siam) to attack French Indo-China. After several months of border warfare, a Japanese-mediated peace in March 1941 gave back to Thailand sections of its old provinces of Laos and Cambodia. Meanwhile Japan, by propaganda and further military infiltration, strengthened its hold on the entire French colony.

Japan's alliance with the Rome-Berlin Axis in a policy of expansion was plainly stated in a pact signed with Germany and Italy Sept. 27, 1940. The pact joined the three nations in an effort to create a "new order" in which Germany and Italy would be dominant in Europe, and in which Japan would assume leadership in "Greater East Asia." The three powers further agreed to fight together in the event of attack by any nation not then engaged in war. Japan sought nevertheless to minimize the possibility of its involvement in the European conflict. In April 1941 it concluded a nonaggression pact with its old enemy Russia that committed the two nations to a position of neutrality in any war in which either was engaged.

JAPAN WRECKS, THEN OCCUPIES, A CHINESE TOWN

Japanese troops here enter Paoting, in north China, after their bombardment has reduced the town to rubble. Chinese guerilla fighters took up the struggle in areas where Chinese regulars had been forced to withdraw.

Obstacles to Japanese Expansion

Despite Japan's hope of profiting from the war, many obstacles continued to hamper development of its ambitious program in east Asia. Its best military and diplomatic efforts were unable to conclude the war in China, and China continued to receive aid from the United States and Soviet Russia. The United States concentrated its fleet in the Pacific and imposed increasingly severe economic sanctions on Japan. Great Britain, with its tremendous stake in India, Australia, and the entire Far East, was not disposed to relinquish easily its imperial interests. Despite the shift of most of its Pacific fleet to more urgent duty in other waters, Britain, by its control of Singapore, held the key to power in southeastern Asia (*see* Singapore). Soviet Russia, despite the nonaggression pact, was still another threat to Japan. Menaced thus on many sides, Japan pursued a cautious policy, seeking profit for itself in the rivalries and conflicts of the other powers. (*See also* Pacific Ocean.)

The United States Helps the Allies

THE OUTBREAK of war aroused in the people of the United States an almost unanimous determination to stay out of Europe's quarrels. There was overwhelming aversion to Hitler and his Nazi Germany; there was keen sympathy for Great Britain and France, and even willingness to lend them material and moral support; but there was, above all, the desire to remain neutral in a war which, many at first believed, neither menaced nor directly concerned the United States.

In accordance with public opinion, the government adopted measures having three broad objectives. The first was to lend aid to the Allies within the limits of the country's policy of neutrality. To this end, Congress in November 1939 amended the Neutrality Act to permit Great Britain and France to purchase implements of war on a "cash-and-carry" basis (*see* Neutrality Policy of the United States). The second objective was to rearm for defense, and the administration forthwith launched the largest rearmament program in the nation's history. The third aim was the strengthening of ties with the other nations of the Western Hemisphere.

Defense of the Western Hemisphere

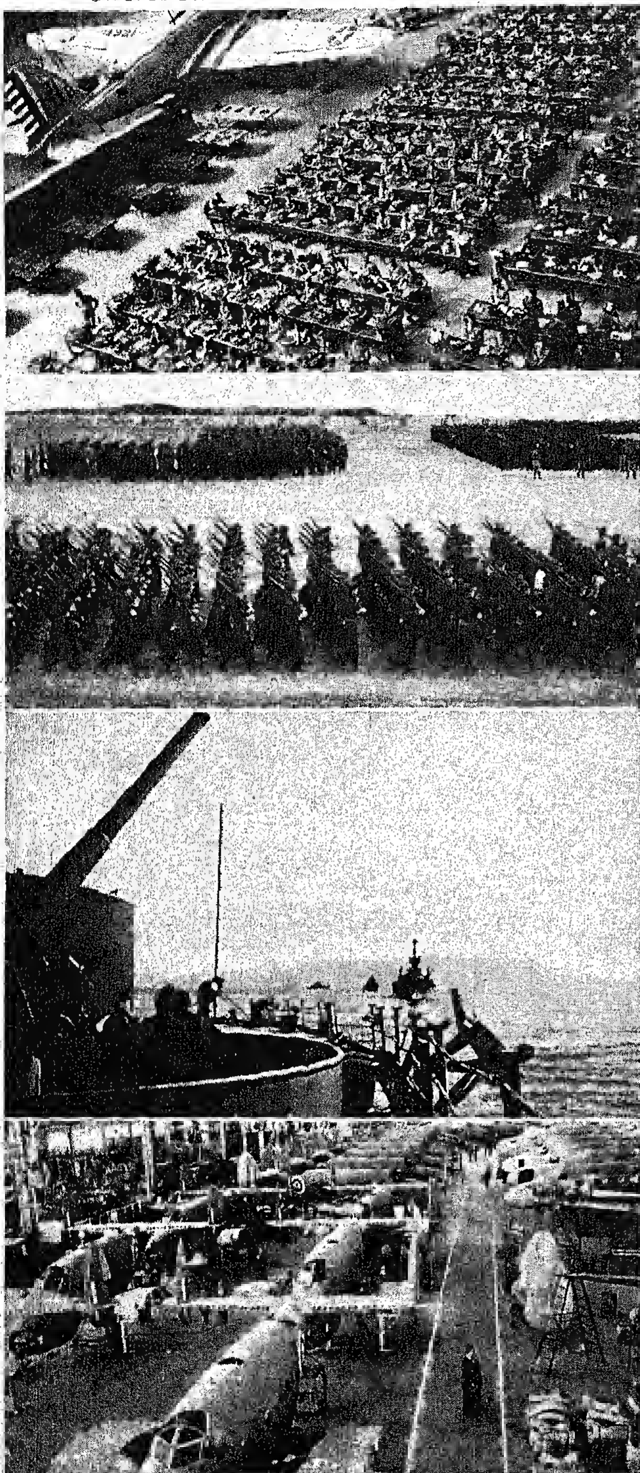
For years before the war the Roosevelt administration, by its "good neighbor" policy, had laid the basis for joint action by the 21 American republics in the face of any crisis. The war proved and strengthened Pan American solidarity. In September 1939 the United States joined the republics of Latin America in establishing a "safety belt" averaging 300 miles in width around the Americas south of Canada. Within this zone the warring powers were asked to avoid all hostile acts. In July 1940 the American republics adopted the Act of Havana, providing for joint trusteeship of any territories in the New World threatened with transfer from one non-American power to another. (*See also* Latin America.)

President Roosevelt's prewar pledge that the country would never permit Canada to be dominated by an invader was implemented by the creation, in August 1940, of a joint board for defense of the northern half of the Western Hemisphere. Hemisphere defense was further strengthened in September, when the United States transferred 50 over-age destroyers to Great Britain, in return for 99-year leases upon sites for air and naval bases in the British possessions of Newfoundland, Bermuda, the Bahamas, Jamaica, St. Lucia, Antigua, Trinidad, and British Guiana.

Response to the Fall of France

Meanwhile Germany's conquest of the Low Countries and France and Italy's entry into the war had left

GLIMPSES OF AMERICAN EFFORT



At the top, members of the Army Air Corps study radio communication at Scott Field near Belleville, Ill. Below, soldiers of the conscript army step smartly in review at Camp Callan near Torrey Pines, Calif. Next, American warships are seen steaming out of Reykjavik Harbor in Iceland, shortly after the United States occupied this Atlantic base. At the bottom are bombers in production, almost ready for shipment to Britain.

Great Britain and its empire fighting alone against the combined might of the Axis powers. This reorientation sharply altered the attitudes of the American people. Whereas most of them previously had been "isolationist," the majority, according to polls of public opinion, now favored greater aid to England even at the risk of war. Most Americans felt that further German victories would directly threaten the security of the United States.

This new situation caused a speed-up of rearmament and the adoption of a policy of all aid to England, short of war. The objectives of the rearmament program were a "two-ocean" navy, strong enough to deal with any probable combination of foes in the Atlantic and the Pacific oceans at the same time; an army which could defend the United States and other nations of the Western Hemisphere against any possible aggression; and an air force of 50,000 military and naval planes. To build quickly an army capable of defending the vast expanse of the hemisphere, the nation in October 1940 adopted peacetime compulsory military service for the first time in its history. (*See also* Army; Navy.)

That the American people supported their government in these policies was affirmed in November 1940 by their re-election of Franklin D. Roosevelt as president. That they recognized the gravity of the world situation was indicated by their willingness to cast aside the long-standing tradition against three terms of office for any president.

Early Efforts to Restrain Japan

Even before the second World War, the United States had opposed Japan's invasion of China and its entire policy of expansion in Asia as unwarranted aggression and a threat to American interests in the Far East. With the wartime alignment of Japan on the side of the Axis and of the United States on the side of the Allies, the conflicting interests of the two nations were thrown into sharp relief.

The United States made clear its intention of preventing any attempt of Japan to dominate the Netherlands Indies, upon which American industry depends for supplies of rubber, tin, and other vital commodities. It also expressed opposition to Japanese aggression in French Indo-China. Backing up these moves, the United States concentrated its fleet in Hawaiian waters.

Effective nonmilitary action was permitted by Japan's economic dependence upon the United States. For supplies of scrap iron, petroleum, and copper to run its war machine; for cotton to feed its textile industry; and for foreign credits with which to trade abroad, Japan relied largely on American sources.

In 1940 the United States government banned shipments of aviation gasoline and scrap iron and steel to Japan and hinted at further embargoes if necessary.

Aid to Britain

Meanwhile the immense productive machinery of the United States was functioning in high gear to make the nation the "arsenal of democracy." After Britain warned that it was nearing the end of its ability to pay for war materials, Congress, in March 1941, granted the President authority to lend or lease arms and supplies to countries whose defense he deemed vital to the defense of the United States. Under the Lend-Lease Act, a steady stream of planes, tanks, guns, and other implements of war rolled off American assembly lines earmarked for Britain.

To get these supplies across the Atlantic into the hands of British fighters, in the face of highly destructive German raids on shipping, became a major problem. The President announced his determination to take any measures necessary to insure their delivery. To this end, as well as to strengthen hemisphere defense, the United States, on April 9, took Greenland under its protection for the duration of the war, by agreement with the Danish minister in Washington. For similar reasons, the United States, on July 7, landed naval forces in Iceland, with the permission of the island's government. American troops supplemented and were expected eventually to replace British forces stationed there. Observational patrols by the United States Navy reported the movements of German and Italian ships in the waters between the American Atlantic coast and Iceland.

With these moves, the United States dominated the strategic approaches to its Atlantic shores. It held bases which would be of inestimable value in convoying supplies to Great Britain. It was also in a better position now to enforce in the north Atlantic the American policy of "freedom of the seas."

Diplomatic Clashes with the Axis

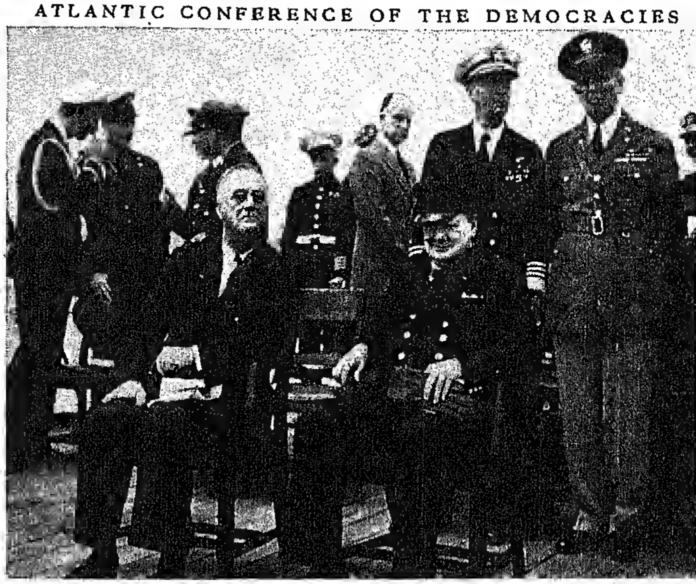
During the summer of 1941, as aid to Britain swelled in volume, relations between the United States and the Axis nations assumed a grim, unconcealed hostility. On March 30, the United States Coast Guard seized German and Italian vessels in American harbors. On June 12, it was officially reported that the American freighter *Robin Moor* had been sunk by a German submarine in the Atlantic on May 21. The President condemned this as an act of "piracy," and said full reparations would be demanded of Germany. On June 14, the President "froze," or prevented the removal of, German and Italian assets. The next week he requested Germany and Italy to close their consulates and other agencies in the United States. In reprisal for these moves, the United States was ordered to close its consulates in Germany, Italy, and Axis-occupied countries. The President proclaimed the existence of an "unlimited national emergency."

A Statement of United States Aims

As the United States drew nearer war, President Roosevelt laid before the world the broad principles which the nation was committed to support. In an address to the 77th Congress, Jan. 6, 1941, he said that the United States looked forward "to a world founded upon four essential human freedoms":

> The first is freedom of speech and expression—everywhere in the world.
>
> The second is freedom of every person to worship God in his own way—everywhere in the world.
>
> The third is freedom from want, which, translated into world terms, means economic understandings which will secure to every nation a healthy peacetime life for its inhabitants—everywhere in the world.
>
> The fourth is freedom from fear, which, translated into world terms, means a world-wide reduction of armaments to such a point and in such a thorough fashion that no nation will be in a position to commit an act of physical aggression against any neighbor—anywhere in the world.

ATLANTIC CONFERENCE OF THE DEMOCRACIES



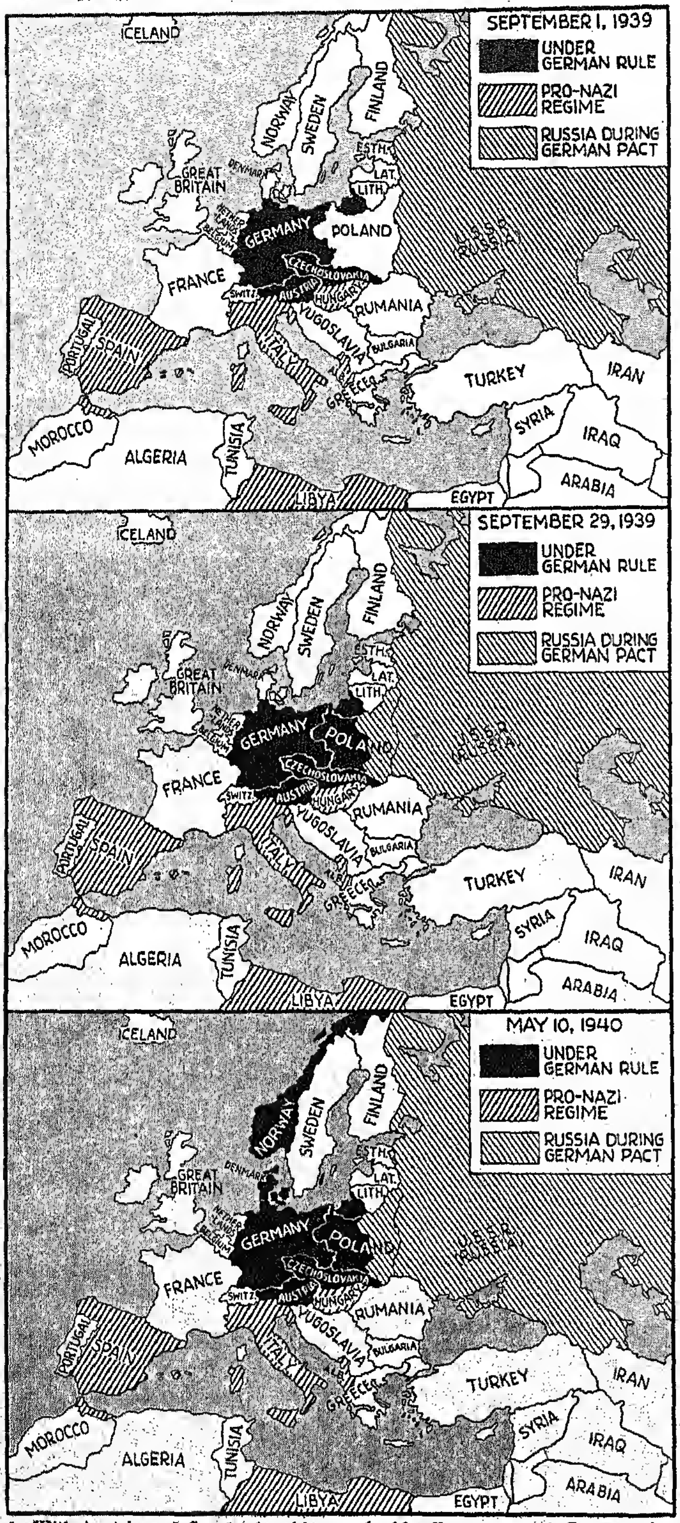
Meeting aboard a battleship for their dramatic conference in August 1941 are (in the foreground) President Roosevelt and Prime Minister Churchill. Behind Churchill are Admiral E. J. King, commander of the U. S. Atlantic Fleet, and Gen. George C. Marshall, chief of staff of the U. S. Army. The civilian in the background is Sumner Welles, American undersecretary of state. At the far left are the President's sons, Ensign Franklin D. Roosevelt, Jr., and Capt. Elliott Roosevelt.

Struggle in the Mediterranean and the Near East

THE FAILURE to achieve a quick victory over Great Britain in the British Isles drove Germany and Italy into a campaign against British power in the Mediterranean region in the winter of 1940–41. This far-flung offensive, along with the campaign against Allied shipping in the Atlantic, was intended to isolate and thus inevitably defeat Great Britain.

The British position in the Mediterranean was based on control of the two bottleneck passages to the ocean

HOW NAZI RULE SPREAD OVER EUROPE—I



1. With Austria and Czechoslovakia won by bloodless conquest, Germany invades Poland. The white areas—almost all hostile to Germany—predominate.
2. As Poland totters under terrific German assault, Russia's armies attack from the east. Poland is dismembered.
3. The black area jumps northward and blots out Denmark and Norway.

—Gibraltar at the western end and the Suez Canal in the east. Against Gibraltar the avenue of attack by land was Axis-dominated Spain; but it was questionable whether the Spanish people, after three recent years of civil conflict, could be effectively used for another war. It was against Suez that the Axis offensive was launched. An Italian attack in North Africa was coupled with a German drive through southeastern Europe. The ultimate objective of this vast pincers movement was to expel the British from the eastern Mediterranean, and thus to sever the "lifeline" leading to the richest sections of the British Empire.

Italy's Failures in Africa and Greece

The new Axis campaign opened in August 1940 with an Italian invasion of British Somaliland. After brief resistance, the British made a strategic withdrawal from the colony. The following month Italy invaded Egypt from Libya, and the Italians advanced across the desert along the coast as far as Sidi Barrâni. At the same time Italy made demands on Greece for the cession of strategic bases. When Greece refused to yield, Italy on October 28 invaded the country from Albania.

In all these ventures, Italy met disaster. In November the British navy dealt a crippling blow to the Italian fleet lying at anchor in Taranto. In December a surprise counterattack by British troops under the command of Sir Archibald Wavell drove the Italians out of Egypt and far back into Libya, destroying and capturing many men and a vast quantity of supplies. Meanwhile the Greeks, fighting fiercely against superior numbers, routed the invaders and pushed into southeastern Albania. At the same time British troops struck at Italian East Africa from Kenya and the Sudan. In April 1941 they entered the capital of Ethiopia, and soon almost all of Mussolini's East African empire was in British hands.

The astounding reverses that followed Italy's first major efforts in the war further reduced the country's morale at home and its prestige abroad. Thenceforth Italy was everywhere regarded merely as a puppet of Germany. Mussolini now looked to Hitler to rescue him from total disaster.

Germany's Drive in the Balkans

In contrast to reverses at the Italian end of the Rome-Berlin Axis, Germany during this time had been successfully carrying out its campaign to gain the Balkans. In August and September 1940 Rumania, under Axis pressure, had been compelled to cede

northern Transylvania to Hungary and southern Dobruja to Bulgaria. Then in October the Nazi-dominated government of Rumania submitted to German occupation of the remainder of the country. Hungary was already under complete Nazi control. Bulgaria also fell to the Germans by occupation on March 1, 1941.

Hitler was now in a position to come to the aid of his Italian ally. Anticipating a Nazi onslaught upon Greece, Great Britain began to land an expeditionary force there. Germany attempted to complete the encirclement of Greece by drawing Yugoslavia into the Axis alliance on March 25; but the enraged Serbs quickly overthrew their government. Then, on April 6, German armies in Bulgaria and Rumania invaded Yugoslavia and Greece.

Campaign in Yugoslavia and Greece

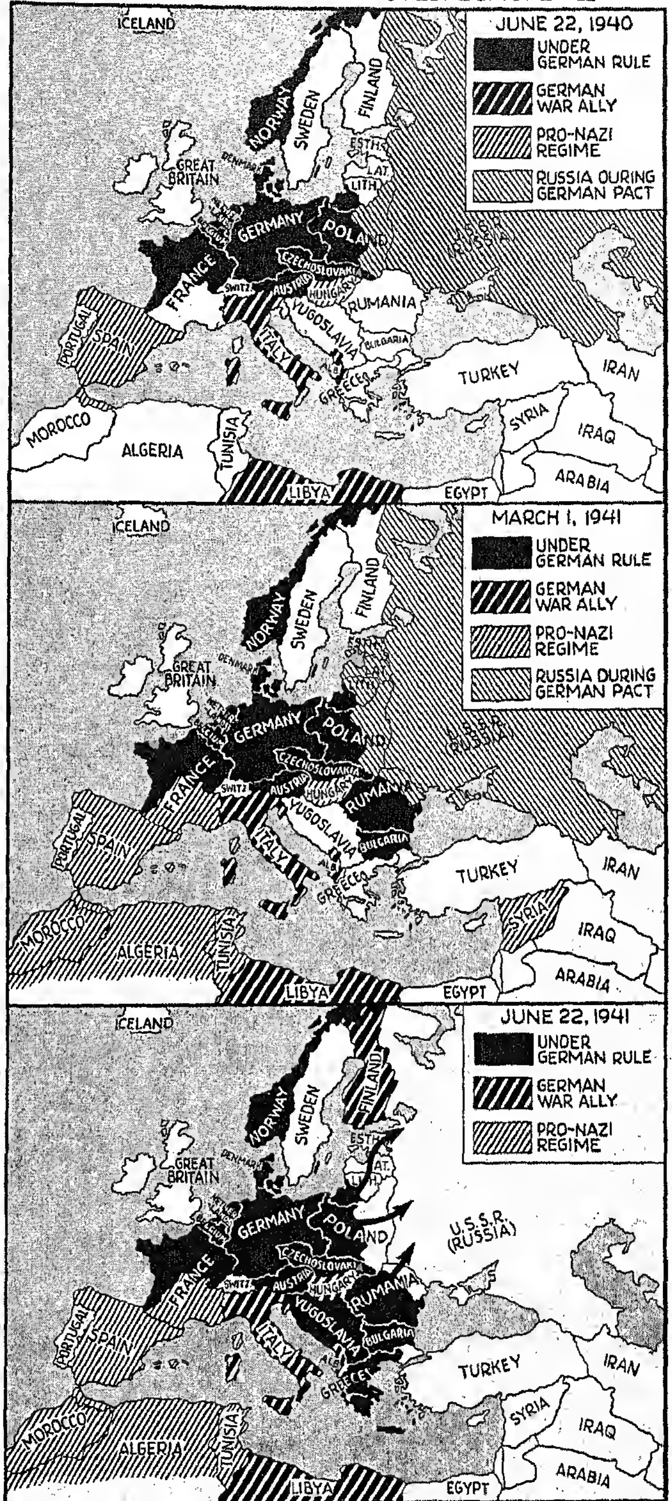
Yugoslavia's ill-trained and outnumbered forces were quickly crushed by German armies in the flat northern part of the country. As Germany's troops pushed swiftly south, its planes rained bombs on Belgrade, which was terribly devastated. Hungary seized sections of its former territories in northern Yugoslavia, and Italian troops advanced along the Adriatic coast. On April 18, after 12 days of *Blitzkrieg*, Yugoslav resistance collapsed. Dismemberment of the young nation began when the Axis set up an "independent kingdom" of Croatia and placed a member of the Italian ruling house on the throne. At the same time Italy annexed outright part of the Dalmatian coast.

In Greece, German armies driving down from Bulgaria overran Macedonia and Thrace, and then pushed west to make contact with the hard-pressed Italians in Albania. In the face of a concerted southward offensive, Greek and British forces retreated slowly from defensive positions in the mountains. The isolated northern armies of Greece surrendered April 23, and thereafter the Allied forces fought only to cover the re-embarkation of British expeditionary troops. From open beaches the British evacuated some 48,000 of their original force of 60,000, mostly Australians and New Zealanders (Anzacs). By May 2, the Germans were in complete occupation. Later that month, German parachute troops descended upon the Greek island of Crete, and in a ferocious land and air assault upon the Allied troops there swiftly conquered also this strategic naval outpost in the Mediterranean.

Battle for the Near East

Along with their drive through the Balkans, the Germans entered the Near

HOW NAZI RULE SPREAD OVER EUROPE—II



4. *Blitzkrieg* crushes the Low Countries and France. Italy enters the war.
5. Rumania and Bulgaria submit to German occupation. By now Russia has absorbed the Baltic States and France is ruled by a pro-Nazi régime.
6. Yugoslavia and Greece are conquered. Germany, master of the continent, turns on Russia. Finland and Hungary join the attack.

Eastern struggle. In April they redeemed Italian losses by expelling the British from Libya. At the same time Nazi propagandists intensified their campaign throughout the Moslem world. The prize at stake were the rich oil fields of Iraq, Iran, and Arabia.

In May the British suppressed a Nazi-supported revolt in Iraq. In Syria, also, Nazi infiltration had been progressing with the consent of the Vichy government of France. On June 8, British and "Free French" forces invaded Syria from the south. After a month of battle with the troops of its former ally, Great Britain won an armistice which provided for the occupation of Syria and Lebanon. By this time, however, the struggle in the Near East was dwarfed by events in a new theater of war.

THE NEAR EASTERN THEATER

At the top are Australian troops in Libya, following their successful drive against the Italians in December 1940. Below, Negro troops from Britain's Kenya Colony pick up the frontier markers from Italian East Africa, and nonchalantly stride ahead. At the bottom, German parachute troops land inside the British defenses during the spectacular Nazi invasion of Crete.

War Between Germany and Soviet Russia

DURING THE SPRING of 1941, signs had been multiplying of an approaching crisis between Germany and Russia. The nonaggression pact of August 1939 had always been regarded by both the signatories merely as a means to achieve certain immediate ends. For Soviet Russia it offered time to build defenses against the possibility of a German attack. For Germany it guaranteed peace along its eastern frontiers during the war in the west. But neither Hitler nor Stalin ever forgot that 'Mein Kampf' had marked out the rich lands of western Russia as a primary objective of Nazi expansion.

In March 1941 Russia had reprimanded Bulgaria for "extending the war" by permitting German troops to occupy Bulgarian territory. In April it had signed a nonaggression pact with the anti-Axis government of Yugoslavia. On Germany's side, a sensational event in May appeared to presage a revolutionary change in Nazi foreign policy. Rudolph Hess, the third highest leader in Germany, flew alone to Scotland, allegedly on his own initiative. He was interned by the British government, and no explanation was immediately forthcoming; but many observers believed that he had brought a proposal for peace between Britain and Germany, preliminary to a war against Russia. Meanwhile Russia and Germany massed their divisions on each other's frontiers.

Germany Invades Soviet Russia

Suddenly, at dawn on June 22, without warning or ultimatum, Germany invaded the Soviet Union. Hitler charged that Russia had violated their nonaggression pact and had conspired with Britain and the United States against Germany. Resuming his traditional rôle as a foe of communism, he attempted to win support for his new venture by calling it a crusade against Bolshevism. Stalin condemned the "perfidious attack" and predicted that Hitler, like Napoleon, would meet his doom in the broad expanse of Russia.

Other nations quickly took sides. Italy, Hungary, Finland, Rumania, and Slovakia immediately declared war on Russia. Great Britain pledged technical and economic assistance to the Soviet Union, and the United States promised material aid. On July 13, the British and Soviet governments concluded a mutual-aid pact in which each agreed not to conclude a separate peace in the war against "Hitlerite Germany."

A Titanic Struggle

The new conflict locked in battle the two largest armies in the world along a front extending 2,000 miles from the White Sea to the Black. Germany struck its heaviest blows on three sectors of this long front: (1) from East Prussia through the Baltic States toward Leningrad; (2) from the northern part of German Poland through White Russia toward Moscow; and (3) from the southern part of German Poland through the Ukraine toward Kief. Thrusts in these directions by German mechanized divisions were accompanied by aerial bombardment of Kief, Sebastopol, Riga, Minsk, and Moscow.

But stiff resistance by the Red army and air force slowed up the *Blitzkrieg* pace of the German drive, and guerrilla warfare behind the German lines menaced the invaders. Wherever they retreated, moreover, the Russians pursued a "scorched-earth" policy, destroying crops and factories and everything else that would be of value to the Nazis. Unless they could quickly crush the immense Soviet army, the Germans would have to endure immobilization during a grueling Russian winter with extended and faulty lines of supply—the same combination of factors that had shattered the armies of Napoleon more than a century before.

By the end of November it became clear that the German assault on Russia had reached and passed the peak of its effectiveness for that year. A last tremendous drive on Moscow failed, and at the same time the German armies were forced to retreat from their farthest point of advance, Rostov-on-Don, the gateway to the Caucasus. Other Russian counteroffensives drove the Germans back from positions near Moscow and Leningrad.. Early in December the Germans officially admitted that snow and cold weather had stopped their Russian offensive for the winter.

Consequences of Hitler's Attack on Russia

HITLER'S DECISION to plunge his country into war with a nation as huge and powerful as Russia, while he was still engaged in a war with the British Empire, astounded the world. Many explanations were advanced for the move, but the reason most generally accepted was that Britain's unyielding resistance and the increasing belligerence of the United States had convinced the Nazi leaders that they faced a protracted struggle with the democracies. In this view, Hitler's attempt to seize the oil, wheat, and minerals of western Russia was by way of preparation for the final conflict with the western powers.

Essential to this scheme, however, was a quick victory over Russia. Until and unless Germany could win this victory, it was confronted with an overwhelming combination of Russian land strength, British sea and air power, and American industrial might. Germany had also to contend with the ever-present factor that it ruled hostile and rebellious peoples who eagerly awaited an opportunity to rise up and destroy their Nazi masters.

Japan's New Bid for Power

One immediate result of the new turn of the war was a stepping up of Japan's program of aggression. The involvement of the Soviet Union in the conflict appeared to offer Japan the opportunity it awaited for bold action. From the unresisting Vichy government of France, Japan in July 1941 obtained sweeping concessions, including bases in French Indo-China that provided almost complete military domination of the colony. Japanese forces of occupation were immediately massed along the Thailand border.

Japan's moves were met by prompt economic reprisals. The United States and Great Britain appeared to regard the invasion of Russia not as a reason for further "appeasement" of Japan but as an interval during which they might strive to curb Japanese aggression. President Roosevelt therefore "froze" Japan's assets in the United States, placing any exports to the country under a rigid licensing system. Similar action was taken throughout the British Empire. The British and American governments furthermore supported the Netherlands Indies in limiting its theretofore large shipments of oil to Japan. This economic warfare was accompanied on all sides by threats of even more drastic action to come.

Allied Invasion of Iran

In the Near East, also, the Allies now took vigorous action. Great Britain and Soviet Russia repeatedly warned Iran to expel the dangerously large number of Nazi agents that had been infiltrating into the country. When these warnings went disregarded, British

"SCORCHED-EARTH" AND GUERRILLA WAR

Two Germans (above) enter a Russian village which has been fired by Soviet troops, in line with Stalin's order to "scorch the earth" before the advancing Nazis. Notice the grenade, to destroy any remnants of opposition. Below, in camouflage, is a Soviet sniper—one of many operating behind German lines.

MOBILIZING RUSSIA'S MILLIONS

News of home and of the progress of the war is brought by this girl newspaper vendor to Red army men entrained for the front. Notice from the faces the variety of racial types.

and Soviet troops on August 25 invaded the country and swiftly occupied it.

Then on September 12, British armies in Egypt, after intensive preparations, struck at Axis forces in the Libyan Desert. They hoped to relieve pressure on the Russians, to remove the threat to Suez, and to obtain additional bases for attack on Italy.

United States Battles Axis Raiders

On September 11, 1941, President Roosevelt ordered the United States Navy to destroy German or Italian raiders operating in American defense waters. One victim of this sea warfare was the American destroyer *Reuben James*, torpedoed off Iceland with the loss of a hundred lives.

Upsurge of Anti-Nazi Movements

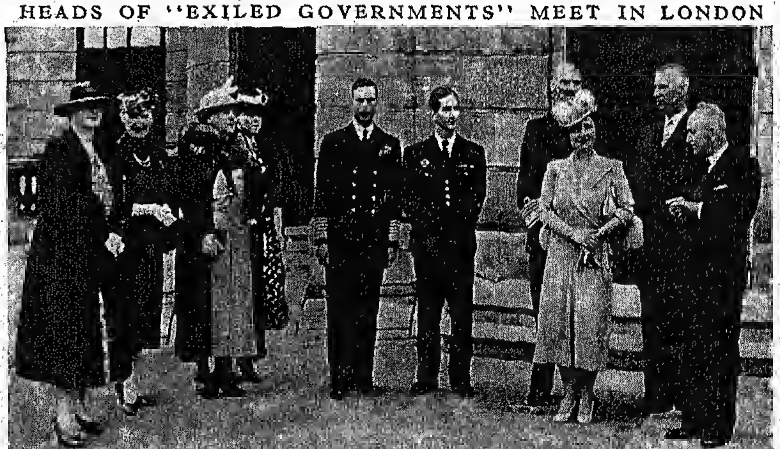
The day the German armies marched into Russia a new wave of anti-Nazi activity surged up all over Europe. In addition to Communist sympathizers and the Slavic peoples who felt a racial kinship for Russia, there were subjugated millions in the occupied countries who saw in the Russian war an opportunity to strike the Nazis from the rear while they were totally engaged on the eastern front. A train mysteriously derailed in occupied France, a munitions plant blown up in Yugoslavia—these were typical incidents in the "silent war" carried on in the occupied countries. Even inside Germany there were reports of growing unrest over the prospect of a long and increasingly bloody conflict. The Nazis retaliated with swift, brutal repression; but they were unable to stem the mounting tide of sabotage and were obliged to devote part of their military strength to the task of policing the invaded nations.

The Allies were quick to give inspiration and direction to the activities of their partisans under Nazi rule. Since the conquest of Poland, representatives of countries successively overrun by the German army had set up headquarters in London to continue the struggle from abroad. These "governments in exile," through leaflets dropped from British planes in Nazi-held territories and through radio broadcasts, kept alive the hope for liberation. To symbolize defiance of their rulers, the people of the occupied countries caught hold of the British-sponsored campaign to flaunt the letter "V" (for victory) everywhere—in paint on the side of buildings, in Morse code in the ringing of bells, in songs, and in countless other ways that harassed and infuriated Nazi authorities. Thus the conquered peoples heralded revolt against the Nazis when the opportunity should arise.

Sufferings of the Civilian Population

A UNIQUE and terrible feature of this war was the extreme suffering it inflicted on the civilian population. With the widespread and deadly use of air bombing, cities and villages became

HEADS OF "EXILED GOVERNMENTS" MEET IN LONDON



In the center is King George VI of England, with King Peter II of Yugoslavia at his left. At the right is Queen Elizabeth of England. Grouped around her (from left to right) are King Haakon VII of Norway, President Raczkiewicz of Poland, and President Benes of Czechoslovakia. At the far left is Queen Marie of Yugoslavia, with Mrs. Benes at her side. Next is Queen Wilhelmina of the Netherlands, with Mrs. Raczkiewicz behind her. The meeting took place at Buckingham Palace.

theaters of battle, and women, children, and old men became warriors in the defense of their lives, homes, shops, and schools. This distinctive character of the second World War was indicated by an estimate that during the first year and a half, the ratio of civilian to military deaths was 1 to 3, whereas in the first World War the ratio was 1 to 75.

Apart from the loss of human life, the damage inflicted by the war was incalculable. Warsaw, Rotterdam, Belgrade, and many of the other great cities of Europe were left in ruins after the bombers had done their work; fields were trampled under and burned by tanks and bombs; and factories, bridges, railroads, and mines were wrecked or destroyed.

Dislocation of Peoples

War has always caused widespread displacements of population, and the second World War was no exception. Even before the war started, refugees had been a problem of international scope. Persecution in Germany, civil war in Spain, the Japanese invasions of China had driven millions from their native soil and sent them wandering in search of refuge.

Never before had the world witnessed population movements comparable to those set in motion by this latest world conflict. The risks to which civilians were exposed were increased by the huge modern armies, the great areas covered by their campaigns, and the widened danger zone resulting from the tremendous range of bombing planes. In Poland, the Netherlands, Belgium, France, Norway, Yugoslavia, and Greece the German offensives drove before them a mounting flood of refugees and evacuees. Many of these unfortunate people were sent to the Reich to do forced labor. Others of the civilian victims of war returned to their homes, or what was left of them, when the hostilities were over. In Russia, however, the unoccupied part of the country gave protection to millions of refugees who could not return to the vast regions still under enemy occupation.

Europe was not the only scene of mass population displacements. In China, some 30 to 60 millions fled their homes in the face of the Japanese aggression. The invasion of Malaya forced many of the white people to evacuate. Advancing Japanese armies drove Indians and Europeans from Burma. Military operations caused population movements in Abyssinia and North Africa. Even in the United States, far from the actual scenes of combat, many thousands of citizens and aliens of Japanese descent or birth were removed from the Pacific coast region of the country and transferred inland away from military establishments and war production areas.

Altogether it is estimated that more than 40 million inhabitants of continental Europe had been torn from their homes since the beginning of the war—to say nothing of the uncounted millions in Asia. These tragic victims of war's ruthlessness created for the postwar world a gigantic problem of repatriation and reconstruction.

Miseries of the Conquered Peoples

Scarcely better was the fate of the vanquished peoples who had to endure the miseries of Nazi rule. Want and privation were their universal lot. Their supplies of food, clothing, machines, and materials of all kinds were drawn upon by the conquerors to replenish stocks in Germany. Men and women were forced, under peril of starvation, to work in mines and factories for the German war machine. Exhibitions of resentment or acts of hostility were punished by fines levied on entire communities. Every attack on a German in an occupied country was avenged by mass execution of innocent hostages.

REFUGEES OF WAR

The faces of these Polish people, waiting miserably for a piece of bread to sustain life, express the mute despair of the common folk. Imagine this line multiplied a million-fold—such was the suffering inflicted by the war upon the people of Europe.

The United States Goes to War

WHEN the Japanese attacked Pearl Harbor in the early morning of Dec. 7, 1941, the last great area of peace was blacked out. The Pacific Ocean turned into a vast battle zone stretching 12,000 miles from Panama to Singapore and 9,000 miles from Bering Strait to the Antarctic Continent. This was the hugest war theater in history. Its thousands of islands, remote and unfamiliar, gained sudden importance as possible scenes of action.

But one result of that attack overshadowed all others. It brought the United States into active combat. And from that moment on, the second World War became world-wide in far more than the geographic sense. All the important units of fighting power in the world were now engaged. Behind them, on one side or the other, were all the world's resources, all its technical skill, all its spiritual and moral forces. Now the total power arrayed on each side could be accurately reckoned. And when this reckoning was made, there could be no doubt of the final outcome.

Japan Makes a Momentous Decision

FOR MONTHS the United States had been negotiating with Japan in an attempt to find a basis for peace in the Pacific. But while protesting their desire for a friendly agreement, the Japanese had intensified their aggressive attitude at home, tightened their bonds with the Axis, and strengthened their military position.

In August they had begun to pour additional soldiers into French Indo-China. In October an ardent militarist, Gen. Hideki Tojo, had been chosen to head a new cabinet of "fiery resolution." Tojo's first speeches had been moderate, and early in November he had sent a special envoy, Saburo Kurusu, to the United States with instructions to discuss definite terms of agreement. But later events revealed that Kurusu's visit to Washington had been only a trick to throw the United States off guard.

As Japan played for time in which to get its armed forces into position for attack, proposals and counter-proposals were exchanged between Washington and Tokyo. On November 26 the American secretary of state, Cordell Hull, proposed full economic coöperation if Japan would withdraw from China and stop collaborating with the Axis. On December 6 President Roosevelt appealed directly to the Japanese Emperor to intervene on the side of peace.

Early the following afternoon Kurusu, accompanied by the Japanese ambassador, presented Japan's reply to the American proposal of November 26. It accused the United States of obstructing the "new order in east Asia" and concluded by saying that further negotiations were useless.

Secretary Hull instantly denounced the statement's "falsehoods and distortions." But the deceit was greater than he realized. Even as he spoke, news of Japan's attack reached the White House.

The Surprise Attack on Pearl Harbor

THE JAPANESE struck without warning. Bombing planes launched at dawn from a carrier ship beyond the horizon appeared over Diamond Head east of Honolulu a few minutes before eight o'clock Sunday morning (1:30 p.m. Washington time). With exact knowledge of their objectives, they flew across the city seven miles westward to Pearl Harbor and began dropping bombs and launching torpedoes. They struck at the warships inside the harbor and those anchored offshore, also at the surrounding forts, barracks, and airplane hangars.

The defending forces of both Navy and Army were taken completely by surprise, but went into action immediately. Other waves of Japanese bombers came over later and submarines large and small joined in the attack. The last raid was beaten off, but the battleship *Arizona* had been sunk, the battleship *Oklahoma* had capsized, three destroyers, a target-training ship, and a mine layer had been sunk, and several other ships were more or less heavily damaged. A number of navy and army planes were destroyed on the ground. The Navy lost 2,730 killed, 656 wounded; the Army, 168 killed, 223 wounded. The known Japanese losses were 3 submarines and 41 airplanes.

United States and Britain Declare War

At the same time and in the same manner the Japanese attacked the Philippine Islands, British Malaya, Hong Kong, Guam, and Wake Island. They sank merchant ships at sea. The next morning they attacked Midway Island and took over Thailand (Siam) with the consent of the Thai government.

Two and a half hours after the attack began on Pearl Harbor, the Japanese declared war on the United States and Great Britain. The following day, December 8, Prime Minister Churchill announced Britain's declaration of war to Parliament, and a few hours later the United States Congress declared that a state of war had existed since the day before.

Japan's Course Inspired by Axis

In a radio address to the nation on December 9, President Roosevelt pointed out that Japan's action was merely the latest move in Axis strategy. He said:

> The course that Japan has followed for the last ten years in Asia has paralleled the course of Hitler and Mussolini in Europe and Africa. Today it has become far more than a parallel. It is collaboration so well calculated that all the continents of the world, and all the oceans, are now considered by the Axis strategists as one gigantic battlefield.
>
> In 1931 Japan invaded Manchukuo—without warning.
> In 1935 Italy invaded Ethiopia—without warning.
> In 1938 Hitler occupied Austria—without warning.
> In 1939 Hitler invaded Czechoslovakia—without warning.
> Later in 1939 Hitler invaded Poland—without warning.
> In 1940 Hitler invaded Norway, Denmark, Holland, Belgium, and Luxemburg—without warning.
> In 1940 Italy attacked France and later Greece—without warning.
> In 1941 the Axis powers attacked Yugoslavia and Greece, and they dominated the Balkans—without warning.
> In 1941 Hitler invaded Russia—without warning.

And now Japan has attacked Malaya and Thailand—and the United States—without warning.

It is all of one pattern.

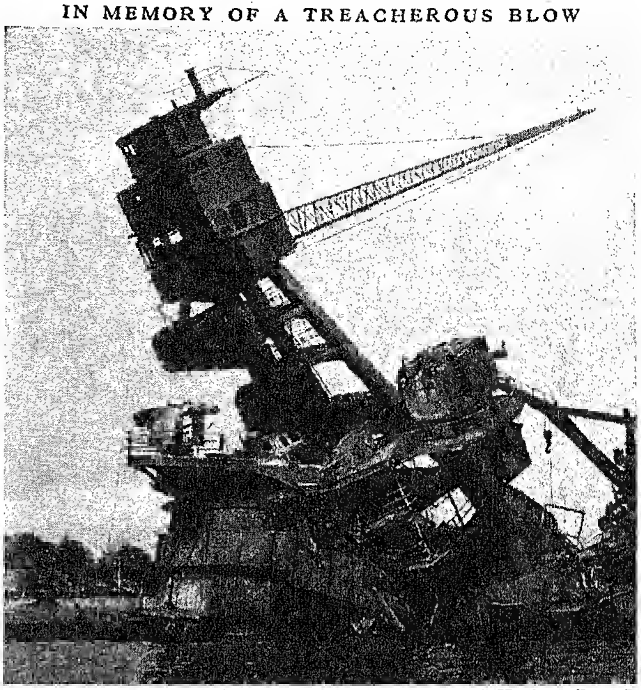
We are now in this war. We are all in it—all the way. Every single man, woman, and child is a partner in the most tremendous undertaking of our American history. . . . We are going to win the war and we are going to win the peace that follows.

And in the dark hours of this day—and through dark days that may be yet to come—we will know that the vast majority of the members of the human race are on our side. Many of them are fighting with us. All of them are praying for us. For, in representing our cause, we represent theirs as well—our hope and their hope for liberty under God.

Other Nations Declare War

On December 11 Germany and Italy declared war on the United States, and Congress voted declarations in return. Two days earlier China, which had been fighting Japan for four and a half years, issued its first formal war declaration, in which Germany and Italy were now included. During the same week nine Latin American nations declared war on the Axis powers—Costa Rica, Cuba, the Dominican Republic, El Salvador, Guatemala, Honduras, Haiti, Nicaragua, and Panama. The Bolivian government declared war against Japan alone. Most of the other Latin American nations either broke off diplomatic relations with the Axis countries or officially expressed their support of the United States government. By way of reply, the Axis powers forced the following puppet governments to declare war on the United States: Bulgaria, Croatia, Hungary, Manchukuo, Rumania, and Slovakia.

IN MEMORY OF A TREACHEROUS BLOW



Wreckage of the battleship *Arizona*, destroyed at Pearl Harbor, Dec. 7, 1941, by the Japanese. The United States Navy published this picture as a reminder to the American people of the score they had to settle.

Japanese Strategy

After their first surprise raids, the Japanese concentrated their chief attacks by sea, air, and land on the Philippines and Malaya. Air attacks were also made on scattered island bases of the United States, Great Britain, the Netherlands Indies, and Australia.

In the Philippines the main effort was directed against the island of Luzon. Air and sea bases gained on this island gave the Japanese command of the ocean lane to Malaya and to the Netherlands Indies. The capture of Hong Kong, 600 miles away on the Chinese coast, was part of the same strategic plan to dominate the South China Sea. The Japanese carefully avoided involving Soviet Russia in their huge Pacific offensive.

THE ORIGINAL 26 UNITED NATIONS

Australia	El Salvador	New Zealand
Belgium	Great Britain	Nicaragua
Canada	Greece	Norway
China	Guatemala	Panama
Costa Rica	Haiti	Poland
Cuba	Honduras	Russia
Czechoslovakia	India	South Africa
Dominican Republic	Luxemburg	United States
	Netherlands	Yugoslavia

These nations signed the original United Nations' agreement in January 1942. Since then the membership has continually increased.

Russia likewise was just as determined to keep the peace along the common frontier because of the need for massing all its strength against the Germans in the west. Thus the situation presented the strange picture of two nations, traditional enemies and allied with opposing sides, studiously avoiding a clash in the interest of dealing with other enemies first.

Declaration of the United Nations

Prime Minister Churchill, accompanied by high British officials, on December 22 appeared in Washington for a historic series of conferences with President Roosevelt and other American military and governmental leaders. On Jan. 2, 1942, 26 nations then at war with the Axis powers joined in a declaration pledging united efforts and no separate peace until victory was achieved. The conference endorsed the eight peace aims drawn up six months previously at the Atlantic conference between Roosevelt and Churchill. That the United Nations chose the American capital for their first meeting was an indication that the United States would play a pre-eminent rôle not only in the conduct of the war but also in the formulation of the peace.

At Rio de Janeiro, on January 28, representatives of the 21 American republics signed an agreement reaffirming their solidarity. The agreement recommended that the republics which had not already done so should break off diplomatic relations with the Axis powers. All complied except Argentina and Chile. The United States was ably represented by Sumner Welles.

(For an account of how the United States mobilized its vast resources for war, *see* Nation at War.)

The United Nations Fight on Many Fronts

NOW the war was a "global war," with battle fronts encircling the earth. Despite the rich gains which conquest had added to Axis power, time remained, as it had from the beginning, on the side of the United Nations. If they could keep their morale high and their alliance firm, the nations arrayed against the Axis could count on their ever-growing strength in trained men and materials.

The Vast Pacific "Theater" of the War

THAT the Japanese militarists long had planned to overrun the entire southwest Pacific area, including even distant India, became unmistakably clear when they struck swift and devastating blows at Thailand, British Malaya, the British colony of Hong Kong, and the American islands of Guam and Wake. These conquests were preliminary to the attainment of two objectives upon which the whole Japanese strategy was based: the seizure of Singapore, the key to British power in the Far East, and the occupation of American bases in the Philippines.

The Japanese sent numerically superior forces against the defenders of the Philippines. The latter consisted chiefly of Filipino reserves with a small force of American and Filipino regulars, commanded at first by Gen. Douglas MacArthur and later by Lieut. Gen. Jonathan M. Wainwright. Withdrawing from Manila on Jan. 2, 1942, the main defense forces retired to the peninsula of Bataan, where they kept the Japanese at bay until April 9. The near-by fortress on Corregidor Island held out until May 6.

Meanwhile, Japanese forces moving south from Thailand had cut through 350 miles of Malay jungles and within eight weeks stood at the gates of Singapore. On February 15 the island fell. Here, as elsewhere, the Japanese had command of the air, and demonstrated the effectiveness of torpedo planes by sinking the British battleship *Prince of Wales* and the heavy cruiser *Repulse* in Malayan waters.

After taking Singapore, the Japanese directed their main attack at the Netherlands Indies, where they used parachute troops and fierce aerial bombardment to batter down resistance. The Dutch with some help from American and British units took a heavy toll of Japanese ships, but island after island of their rich empire fell; and in March the richest prize, Java, was occupied.

Invasion of Burma and Threat to India

While this first phase of the Pacific war was coming to a close, the Japanese had already laid the foundation for the second phase. From their foothold in Thailand, they had invaded southern Burma and captured the cities of Moulmein and Rangoon. Now they struck north into the heart of the country. Small British and Indian units aided by Chinese troops fought desperately, and the small American Volunteer Group ("Flying Tigers") under Brig. Gen. Claire L. Chennault shot down hundreds of enemy planes. But the Japanese had superior ground forces, better knowledge of jungle fighting, and the help of many anti-British Burmese natives. Mandalay fell on May 1. Evacuation became a virtual rout, and by May 15, 1942, Burma was in Japanese hands.

From their new bases on the Bay of Bengal, the Japanese thrust out and captured the Andaman Islands and sent their airplane carriers to bomb the coast of India and the island of Ceylon.

Threat to Australia's Supply Line

At the other end of their line of advance, the Japanese had consolidated their positions at Rabaul in New Britain and on the northern coast of New Guinea. They built a well-organized and formidable network of land, sea, and air bases running from Timor on the south to the Solomons on the east. These not only threatened the supply line from the United States to Australia, but made possible heavy bombing attacks on Darwin, northern Australian seaport.

First Successes against Japan

Up to this time the United Nations had fought purely defensive actions. In an effort to distract the Japanese while Australia was being strengthened, American naval forces based at Hawaii had raided enemy bases on the Marshall and Gilbert islands, on Wake Island, and on Marcus Island. On April 18, 1942, army medium bombers, taken to within about 800 miles of the Japanese coast by the aircraft carrier *Hornet* and led

BRITISH CAPTIVES HEAR OF SINGAPORE'S FALL

The Japanese seized hundreds of British and American civilians in Shanghai, Hong Kong, and in Japan itself. All were treated with insolence and many with cruelty. Here a Japanese officer is reading to a group of prisoners in Shanghai the news of the fall of Singapore. The man who is holding the cap in his hand is an officer of the British merchant marine.

by Brig. Gen. James H. Doolittle, had bombed Tokyo.

Coral Sea, Midway, and the Aleutians

Then, during the first week in May, the United States struck its first real counterblow in a unique sea battle in which surface craft never engaged one another. A Japanese invasion fleet moving into the Coral Sea from the Solomon Islands was attacked by American carrier-based planes and army bombers from Australia and New Guinea. Japanese carrier fliers engaged the American forces in an action that lasted from May 4 to May 8. The United States aircraft carrier *Lexington* was lost, but Japanese losses were so much heavier that they had to turn back. A month later American navy patrol bombers sighted another and much larger Japanese invasion fleet, about 80 ships in all, steaming toward Midway Island. On June 4, carrier planes from a naval squadron joined land planes from Midway in a two-day attack on the Japanese ships, during which the American aircraft carrier *Yorktown* was lost, together with a destroyer and 33 planes. The Japanese lost four aircraft carriers, two heavy cruisers, three destroyers, and 275 planes.

AMERICANS "MOPPING UP" JAPANESE ON ATTU

These American troops are cautiously approaching a crudely made Japanese gun emplacement on the barren island of Attu while routing out the invaders, who have refused to surrender. Smoke from a hand grenade still rises from one of the dugouts.

Meanwhile Japanese carrier planes attacked Dutch Harbor in the Aleutian Islands, and shortly afterward landing forces occupied Attu, Agattu, and Kiska islands. Constant American aerial bombardment drove the enemy from Agattu by November, but the Japanese continued to reinforce the other two islands under the protecting cover of the stormy Aleutian weather.

Action in the Solomons and New Guinea

The first definite offensive against Japan had begun Aug. 9, 1942, in the Solomon Islands. There, United States Marines had seized Tulagi harbor and an airfield on Guadalcanal Island. The ensuing bloody struggle had ended Feb. 9, 1943, with the withdrawal of the routed Japanese from Guadalcanal. The attack, directed by General MacArthur—who had transferred his headquarters to Australia after the fall of Bataan—then shifted to New Guinea. Combined Australian and American troops, starting from Port Moresby, blasted the Japanese from the interior of the island to the north coast, where enemy bases at Gona, Buna, and other points fell to the Allies.

In March a Japanese troop convoy was sighted in the Bismarck Sea by the Allied land-based air forces. In the greatest victory achieved up to that time by airplanes acting alone against naval forces, the entire convoy of ten Japanese cruisers and destroyers and twelve transports was destroyed with a loss of 15,000 men. Eighty-two Japanese planes also were shot down at the cost of only one American bomber and three fighter planes.

Americans Strike Back in the Aleutians

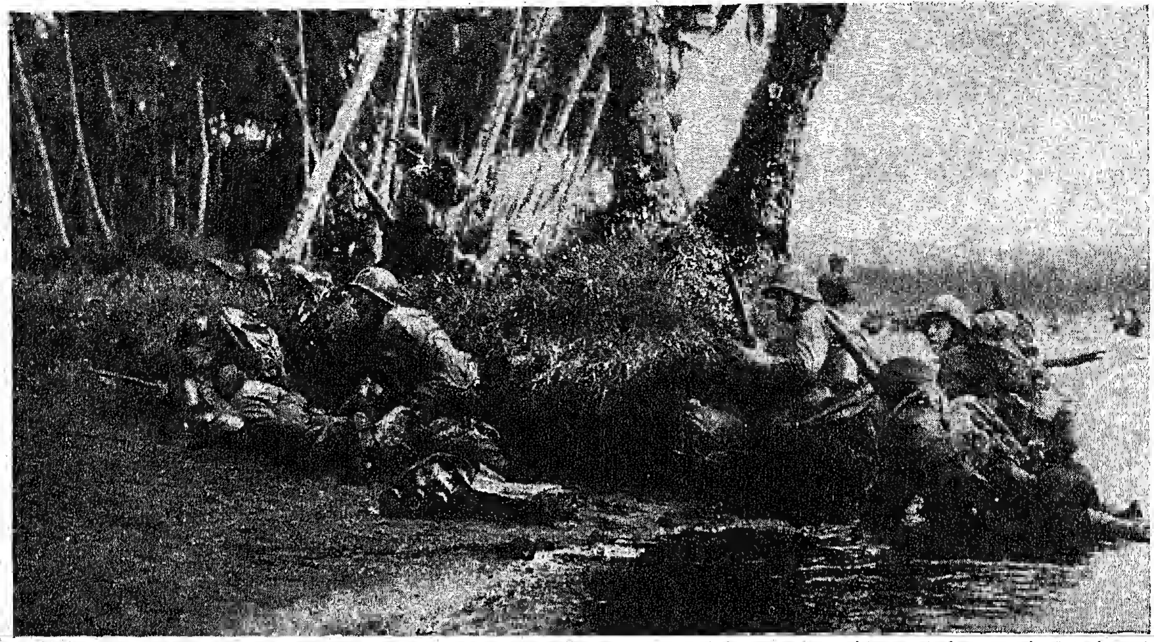
On May 11 strong United States forces landed on Attu Island in the Aleutians and began the long-awaited offensive to dislodge the enemy from their bases on American soil. The attacking force by-passed the Japanese stronghold of Kiska Island to surprise the defenders of Attu. After 12 days of desperate fighting, the encircled Japanese made a last desperate counterattack. Virtually all were killed or committed suicide, and the Americans once again possessed the barren but strategic island.

Allied Offensive in Southwest Pacific

Early in the morning of July 1, Allied land, naval, and air forces, under the direction of General MacArthur, attacked the Japanese on Rendova and New Georgia islands in the Solomons. At the same time the Allies renewed their assault on the enemy in New Guinea in the vicinity of Salamaua. By means of these attacks the Allies hoped to wrest the initiative from the Japanese in this sector. Several days after these battles started, Japanese and American warships clashed in the Kula Gulf off the northern coast of New Georgia. The Americans sank six Japanese ships and damaged four others in the engagement. One United States cruiser was lost. The Americans followed up their naval victory with landings July 8 at two places near the Japanese air base at Munda on New Georgia. Meanwhile, Australian jungle fighters pressed back the Japanese defenders of the enemy base at Salamaua in New Guinea.

After consolidating their beachhead positions, the Americans on New Georgia drove forward through

BEGINNING TO TURN THE TIDE IN THE PACIFIC



Attacking at daybreak in a heavy rainstorm, these American soldiers were part of the first wave of troops to land on the beaches of Japanese-held Rendova Island. Their successful assault opened the drive that swept the Japanese from many strong positions in the central Solomons. The men in the foreground, who are establishing a beachhead before moving inland, are using the scanty natural cover of trees and bushes to escape the bullets of Japanese snipers.

Japanese resistance in the dank jungles surrounding the airfield at Munda. By July 13 the Americans had pushed to within two miles of the airdrome. On this date a second naval battle was fought in Kula Gulf when American ships intercepted enemy craft trying to reinforce Munda. A Japanese cruiser and three destroyers were sunk, raising the total of enemy losses to 14 cruisers and destroyers sunk or damaged in the Japanese attempts to help the beleaguered garrison.

Yard by yard the determined American troops, aided by tanks and flame throwers, pressed forward through the jungle around the airfield. They reached it August 6 and quickly annihilated the few Japanese who stood their ground. Those who escaped northward to the harbor of Bairoko held out until August 28, then fled across the Kula Gulf to Kolombangara Island, and the conquest of New Georgia was completed.

Meanwhile, American and Australian forces continued their drive against Salamaua on New Guinea. The Japanese gradually fell back as Allied planes pounded the enemy coastal supply barges and the airdromes above Salamaua. On September 7, American paratroops dropped into the valley behind Lae, a few miles to the north of Salamaua, and completed the encirclement of 20,000 Japanese in that sector. With this corridor for escape closed behind them, the Japanese gave up Salamaua September 12, and Lae was captured four days later. Then on September 23, MacArthur's troops landed by sea and air near Finschhafen and attacked that enemy stronghold east of Lae. After a ten-day siege, Australian troops captured the sea and air base October 3.

Eight days later, American troops occupied Vila, Japanese air base on Kolombangara Island, off the western end of New Georgia. This victory prefaced General MacArthur's next offensive that opened on November 2. On that date Marines under his command invaded Bougainville Island, the largest and westernmost of the Solomon group. This was a formidable stronghold defended by some 45,000 of the best troops in the Japanese army.

Meanwhile, a series of heavy air raids were made on the great Japanese base at Rabaul, on New Britain Island, which lies between the Solomons and the New Guinea coast. Hundreds of enemy aircraft and scores of naval vessels were destroyed. This prevented reinforcements from reaching the Japanese ground forces already under attack, and paved the way for the invasion of New Britain itself.

Americans Recapture Kiska

All the action, however, was not confined to the southwest Pacific. For two weeks (August 1–14) American heavy and light bombers, dive bombers, and fighter planes had roared 106 times over Kiska in the Aleutian Islands, dumping tons of bombs on the enemy positions. On August 15, American and Canadian troops had landed on the island prepared to meet tremendous resistance. But the Japanese had already fled, presumably under cover of heavy fogs, and the one-time strong enemy air and submarine base on Alaskan soil was once again in American hands.

American Drive in the Central Pacific

The Allied strategy for cracking the outer ring of Japanese island defenses in the Pacific took the form

of a pincer movement designed to trap the enemy at Rabaul and surround the even larger base of Truk in the Carolines, 800 miles to the north. MacArthur's drive in the Solomons constituted the left-hand thrust of the encirclement. The other thrust was directed by Admiral Nimitz in the central Pacific. On November 21, Marines under his command landed on Makin, Tarawa, and other islands of the Gilbert group, about midway between New Guinea and Hawaii. Makin was quickly subdued; but it required 76 hours of the toughest fighting in the 150-year history of the Marine Corps to conquer the Japanese on Tarawa.

The Allied attack in this sector went ahead at an accelerated pace after the turn of the year. On Feb. 1, 1944, American troops invaded the heart of Japan's strongly fortified Marshall Islands. They landed on Kwajalein atoll and within a week wiped out all enemy resistance. On February 16, American heavy bombers blasted Ponape, 400 miles east of Truk. This attack was followed by another the next day, when a powerful task force of the United States Pacific fleet bombed and shelled Truk itself. The Japanese lost 11 warships and 201 planes. Then the Americans struck at Eniwetok, westernmost of the Marshalls, and captured that atoll February 21. Allowing the enemy no respite, an American airplane carrier force raided Japan's Mariana Islands on February 23. The attack on the Marianas—only 1,400 miles from Tokyo—was the second deepest American thrust toward Japan since Doolittle's raid almost two years earlier.

Drives in New Britain and Admiralty Islands

Meanwhile, General MacArthur's forces had landed December 15 at Arawe on the southwest coast of New Britain and driven the enemy inland. Eleven days later they had forced another landing at Cape Gloucester at the western end of the island. Then on March 1, American troops invaded the Admiralty Islands in a surprise maneuver that further tightened the Allied encirclement of the Japanese at Rabaul and cut the enemy's supply lines. All vital areas of the Admiralties were under American control by March 20.

After this victory it appeared likely that MacArthur's offensive in the southwest and the Navy's drive across the central Pacific would converge more and more toward the Philippine Islands. A step in that direction was taken March 29–31, when strong American naval forces several times attacked Palau Island, less than 600 miles from the Philippines.

The Russian "Theater" of the War

In December 1941 the Red army had checked the Nazi drive at the gates of Moscow. In mid-month the Russians launched a counteroffensive which, aided by the Nazis' inability to withstand the piercing cold of the Russian winter, carried the Russians back to the main German centers of resistance, and by spring the Red army had regained one-sixth of the territory it had lost. Then warmer weather brought a renewal of the German assault. This time the drive was two-pronged; one spearhead was aimed at Sevastopol on the Black Sea, which fell July 1, 1942; the other was launched at the Caucasus oil fields. The latter offensive pushed through Rostov-on-Don on July 28, Maikop on August 9, and the naval base at Novorossisk, on the shore of the Black Sea, September 11. Then the Red army rallied to stall the drive just short of Grozny, within a hundred miles of the Caspian Sea.

In the north the Russians also held the Germans around Voronezh; so, in an effort to cut through and divide the Russian defense system, the Nazis attemped to cross the Volga River at Stalingrad. There, however, they met a disastrous setback.

Russia's Great Counterdrive Begins

The battered Red army determined to die to the last man in the streets of Stalingrad before allowing the city to fall into Nazi hands. In the face of such stubborn resistance—a house-to-house resistance that frequently limited a day's gains or losses to only a few yards—the mighty German striking power spent itself. Finally on Feb. 2, 1943, the decimated German forces—leaving 300,000 dead on the battlefield—beat a hasty retreat westward.

The courageous defense of Stalingrad set in motion a stupendous Red army counterdrive all along the vast front. From January 2 to March 12, German strongholds at Velikie Luki, Voronezh, Maikop, Kursk, Rostov, Kharkov, Rzhev, and Vyazma fell in rapid succession before the Russian onslaught.

The principal objective of the Russians was Smolensk on the central front; but a hundred miles east of that key point stiffened German resistance, abetted by the springtime mud of the Russian plains, halted the Red counterattack. In the south too the Russians overextended themselves a bit, and fresh Nazi reserves drove the Russians back a hundred miles, recapturing Kharkov on March 14.

The Red Offensive Gains Momentum

The Germans made the first move to break the midsummer deadlock when they started a long-expected and overdue offensive July 5 in the Orel-Kursk-Belgorod sector. The Nazis made some slight gains for several days. Then the Red army's resistance stiffened, and on July 15 the Russians launched a counterattack. They swept the Germans back through the strongholds of Orel and Belgorod on August 5, then surged on against German-held Kharkov, Bryansk, and Smolensk.

The Red army drove a 43-mile-wide spearhead into the Ukraine and outflanked the big German base of Kharkov. Simultaneously the Russians made general advances farther north in the vicinity of Bryansk and Smolensk. So intense was the Russian drive along the whole 500-mile front that the Germans fled in disorder, leaving great quantities of war material and thousands of prisoners in Russian hands. On August 15, Red army troops smashed into the outskirts of Kharkov to begin a bloody eight-day, street-to-street struggle with its German defenders. Finally the determined Soviets rewon the fourth largest city in Russia on August 23. The recapture of Kharkov

threatened the whole German defense structure and presaged even greater efforts by the Russians to force the Germans back to the last great natural barrier afforded by the Dnieper River.

Russians Continue Westward Drive

The Red army threw its greatest might against the Germans in two sectors: the Donets River basin to the south and the Bryansk-Smolensk area in the central part of the front. In the Ukraine the Russians fanned out west and south and swiftly launched a vast encircling movement in which mechanized divisions and Cossack cavalry drove to the Azov seacoast west of Taganrog. That Nazi bastion yielded August 31, and its fall constituted the greatest single German defeat since Stalingrad. More than 35,000 Nazis were killed in the debacle. The Germans continued to fall back before the irresistible Russian drive, giving up Mariupol on September 11 and Melitopol on October 24. Meanwhile the Red army had stormed into the vital railway center of Stalino about 75 miles north on September 9 to complete the rout of the Germans in the Donets salient.

RUSSIA'S COUNTERDRIVE AGAINST THE NAZIS

The white arrows show the progress of the Russian counteroffensive at the beginning of 1944. The shaded area represents the extent of the farthest Nazi advance.

On September 17, Russian troops recaptured the naval base at Novorossisk on the Black Sea to open the way for an attack on the Crimean peninsula.

The Russians matched their Ukraine offensive with an attack just as devastating on the central front. They had seized Konotop, important railway junction, September 7 to cut the Nazis' rail link between Kiev and Bryansk. A few days later, Russian divisions had outflanked Bryansk and captured the city in a skillful maneuver that routed over 70,000 Nazi troops. Then on September 25 the Germans evacuated Smolensk in the face of advancing Russian forces.

Following up their advantage, the Russians threw spearheads across the Dnieper in several places above and below Kiev. They finally achieved a major breakthrough in the German defense line, poured into the gap, and rolled forward to engulf Kiev on November 6. The Reds continued to extend the "Kiev bulge" in the German defenses, and on November 26 the Nazi stronghold of Gomel fell to the Russians' drive. All the German skill in defensive maneuvering could not keep the Reds from pressing on to capture the key rail center of Zhitomir on January 1. Three days later the Russians crossed the 1939 Polish border.

Russians Surge Onward in 1944

The Russians relentlessly pursued their foe and by January 13 had captured the railway town of Sarny, 35 miles inside old Poland. About two months later—on March 27—the Red army had advanced close to the 1939 Russian-German partition line in Poland. Meanwhile, the Red army had broken through the German lines in the north around Leningrad and Lake Ilmen on January 19. On February 3 Russian troops smashed over the Estonian border and by February 18 were threatening the railway hub of Narva. On the same date, Soviet forces advancing along the shores of Lake Ilmen captured Staraya Russa, heavily fortified rail junction protecting the heart of the German northern front. These victories freed Russian troops to renew the fight with the Finns; the year-long lull in this sector had ended February 6, when Russian bombers blasted Helsinki, the Finnish capital.

The Russian offensive in the north was matched by new and even more vigorous attacks in the Ukraine. The usually successful Russian encircling tactics trapped and destroyed 10 German divisions in the vicinity of Korsun on February 18. Five days later Krivoi Rog, Ukraine iron ore city, fell to the Russians. Then on March 14 they captured German bases near the Black Sea and drove forward to surround and cut off the great seaport of Odessa. By March 27 the Russians had retaken almost all the prized Ukraine and had reached the Prut River frontier of Rumania.

From the beginning of the German drive into southern Russia in June 1942, Premier Stalin and the Soviet

leaders had demanded that Great Britain and the United States make a "second-front" assault on the Nazis in continental Europe to divert from the Red armies some of the German pressure. Before Russia's allies could attempt such an attack, however, they first had to deal with the critical situation confronting them in the Mediterranean area.

The European "Theater" of the War

BY THE FALL of 1942, Axis troops had struck three times across northern Africa in vain attempts to crush the British forces guarding Egypt and the strategic area of the Middle East. Italians made the first fruitless attack, Germans the second. Each time the valiant British stopped their numerically superior foes.

Then in May 1942, German Marshal Erwin Rommel's famed *Afrika Korps*, greatly reinforced, launched the third drive that carried to within 70 miles of Alexandria before the British were able to cry "halt" at El Alamein. There they held firm at the narrow passage between the impassable Qattara Depression and the sea. During the next three months' stalemate, Gen. Harold Alexander took the reins of command and Gen. Bernard L. Montgomery was put in active charge of the forces in the field. New supplies of men, guns, tanks, and planes—including American tank units and planes—were added to the British striking force.

The Axis Is Crushed in Egypt

Finally on Oct. 23, 1942, the British Eighth Army began a devastating assault against the German positions. British infantry, operating mostly under cover of night, cleared a path for their tanks through the enemy mine fields, and Rommel's tank force was routed in a furious action. Abandoning six Italian divisions to their fate, the Germans fled westward, harried by overwhelming Allied air power. By November 6 the British had driven the fleeing Germans from Egypt, and their relentless 1,300-mile pursuit of Rommel along the shores of Libya carried them victoriously into the Axis seaport of Tripoli Jan. 28, 1943. Still the British dogged Rommel until his weary forces found refuge in February behind the fortified Mareth Line in southern Tunisia.

Americans Invade North Africa

Meanwhile, in the early morning of Nov. 8, 1942, powerful American forces under the command of Lieut. Gen. Dwight D. Eisenhower had landed at numerous points on the Mediterranean and Atlantic coasts of French North Africa. The strategic points in Algeria and Morocco were captured in a few days and the Americans were immediately reinforced by the strong British First Army sent from England. The brief resistance of the French changed to collaboration, and French forces under General Giraud rallied to the United Nations' cause. The task ahead was the capture of the remaining Axis strongholds in Tunisia.

In northern Tunisia, the Germans under the command of Col. Gen. Jurgen von Arnim held the towns of Bizerte and Tunis. About 200 miles to the south, Rommel crouched behind the Mareth Line. In between stretched a 75-mile-wide strip of rugged terrain with Axis troops, tanks, and artillery in command of the principal heights and passes. The responsibility for ejecting them from these positions was delegated to Eisenhower. He was elevated to the rank of full general and on Feb. 6, 1943, was appointed commander in chief of all United Nations' forces in North Africa.

Combined British-American-Fighting French forces pounded the German positions in the western Tunisian mountains with tanks and air power. Simultaneously, Montgomery's veterans in the south flanked the Mareth Line on March 29. The Allied pincer movement forced Rommel's *Afrika Korps* to flee northward, abandoning their supply ports of Gabes, Sfax, and Sousse to the Eighth Army. By mid-April the Germans were left in precarious possession of only their two remaining strongholds, Tunis and Bizerte. Then on May 7 overwhelming Allied land and air forces turned the Nazis' own "blitz" tactics against them and quickly captured those two objectives. In a short and furious "mopping up" action that followed, tens of thousands of veteran German troops, among them General von Arnim, surrendered to the victorious Allies.

Thus, with the complete destruction of Axis might on the African continent, the stage was set for the Allies to press home their hard-won advantage against the foe.

The "Battle of the Atlantic"

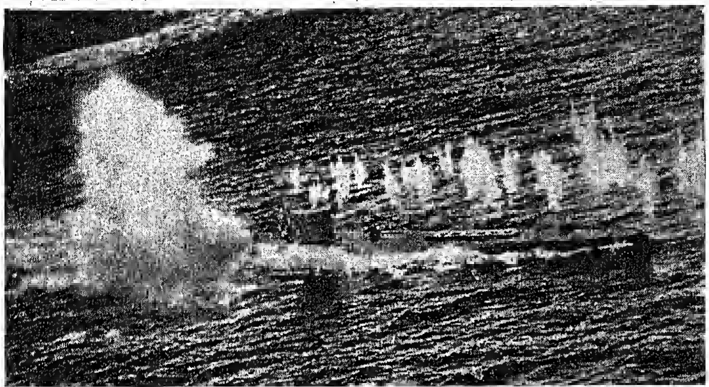
Aware that their chief hope of thwarting an invasion of "Fortress Europe" lay in cutting the Allies' North Atlantic supply lines, the Germans had launched large-scale submarine attacks against Allied convoys early in 1943. The Nazi U-boat program—which kept 500 to 700 craft prowling the sea lanes in "packs"—had met with early successes that claimed about 700 merchant ships as victims before the Allies developed tactics that began to exact a heavy toll from the undersea raiders.

The new Allied strategy embraced two techniques: (1) bombing the enemy submarine bases on the German-held French coast; and (2) convoying ships by long-range bombing planes based at either side of the Atlantic. Later, "baby" escort carriers, converted principally from merchant ships, were added to convoys. By midsummer German submarines were being destroyed so fast that Allied shipping losses were cut sharply. In fact, so effective was the Allied counterwarfare against the Nazi U-boats that not a single Allied vessel was sunk in the North Atlantic during the four months ended September 18.

But the Allies had not yet seen the last of the submarines. In September the Atlantic once more became one of the war's most important battlegrounds as the German U-boat fleet made a final attempt to sever the strategic supply line from America to Britain. The Germans developed a magnetic torpedo which was exploded by the screws of the ship at which it was aimed. They also equipped their submarines with heavy

antiaircraft guns with which they dueled the Allied planes. And German inventiveness originated a radio-controlled bomb which Nazi bombing planes directed against Allied surface vessels. With these new weapons, Hitler's last reserve of 150 to 200 newer and bigger submarines went into the last round of the battle of the Atlantic. Against the revived German attack the Allies marshaled the forces which beat the U-boats in the spring and improved the tactics which won that victory. More "killer groups" of bombers and more fast surface craft—destroyers and destroyer escorts—were available. By the end of the year the Allied submarine fighters were confident that the final victory would be theirs.

SHOWERING SUDDEN DEATH ON ENEMY SUBS



Destroyers and planes from Allied "baby flat-tops" wreaked a terrible vengeance on the Nazi U-boat packs that prowled the Atlantic during 1943 to prey on convoys. In the top picture, a depth charge explodes alongside a German sub as an American plane strafes it with machine guns. Below, depth bombs dropped by a patrol bomber straddle another enemy "pig boat."

Allies Blast Germany from the Air

The bombing of the German submarine "nests" at Lorient, St. Nazaire, and other points on the French coast was part of the larger Allied campaign to pour destruction on Germany from the skies in 1943. During the first seven and one-half months of the year, 75,000 tons of bombs were dropped on industrial centers by the British R. A. F. This was more than twice the load dropped on Germany in all 1942 and more than twice the weight that fell on Britain during the 12 worst months of the German *Luftwaffe* "blitz." This gigantic aerial pounding of Germany constituted the Allies' reply to Russia's pleas for a European "second front" until such time as Britain's and America's leaders should decide that circumstances augured the success of an actual land invasion.

Several individual Allied raids stood out because of their extreme violence or because they wrought destruction on particularly important targets. One such raid was conducted by British bombers June 29 on Cologne, vital Nazi railway and munitions center. The R. A. F. rained 2,000 tons of bombs on military objectives in the nighttime foray. Shortly thereafter, Hamburg, the second city of Germany and the second port of Europe, suffered almost complete extinction in six R. A. F. night and two American day raids. These forays caused more consternation in Berlin than any other event in the war up to that time and precipitated an evacuation of the German capital.

On August 1 another raid proved particularly damaging to the Axis. An American bomber force of 175 planes flew a 2,400-mile round trip from North Africa to bomb the Ploesti oil fields of Rumania. Three hundred tons of explosives were dropped on fields that supplied one-third of the oil for Hitler's war machine. Two weeks later, planes of the American 9th Air Force again took off from North Africa on a 2,500-mile flight to bomb a German aircraft factory at Wiener Neustadt, Austria. Because this city was only a bit south of the deepest penetration into Europe by planes based in England, the raid demonstrated that no point in Greater Germany was immune to attack by air. Then August 25 unveiled a new Allied air bombing technique. On that date, American "Flying Fortress" bombers made the first daylight "shuttle" raid. The planes took off from England with full bomb loads, went deep into the Reich to bomb a plane factory, and then landed in North Africa. The next day the planes took on fresh bomb loads, left North Africa, and returned to England, bombing another aircraft plant at Bordeaux, France, en route.

Destruction Rains on Berlin

Then in the fall, the earlier fears of Berlin's residents began to be realized when the German capital felt the impact of Allied bombs in a series of raids from late August through December. These raids reached their greatest intensity in the air assaults of November 21–December 4, when 1,000-plane armadas of R.A.F. bombers deluged the city almost nightly with thousands of tons of bombs. It was reported that four-ton "blockbuster" bombs and incendiaries

"FLYING FORTRESSES" BOMBARD GERMANY

Daytime "precision" bombing by American planes devastated military objectives at many points in Germany. Here a great column of smoke rises from a Nazi airplane plant demolished by the accurate "egg laying" of bombardiers belonging to the 8th Air Force Bomber Command based in England.

left half of Berlin in ruins. The raids continued on into 1944, and on February 16 the greatest aerial assault of the war poured 2,800 tons of bombs on the battered Nazi capital. Elsewhere over Germany in 1944, increasing numbers of American planes joined R.A.F. bombers in raining destruction on enemy aircraft factories deep inside the Reich.

Allies Overrun Sicily

The warfare against the Nazi submarines in the North Atlantic and the gigantic air bombing raids into all sectors of "Fortress Europe" were the necessary prelude to any future attempt to breach the German-European defenses by invasion. Meanwhile, the Allies gave the Axis no respite after the conquest of North Africa.

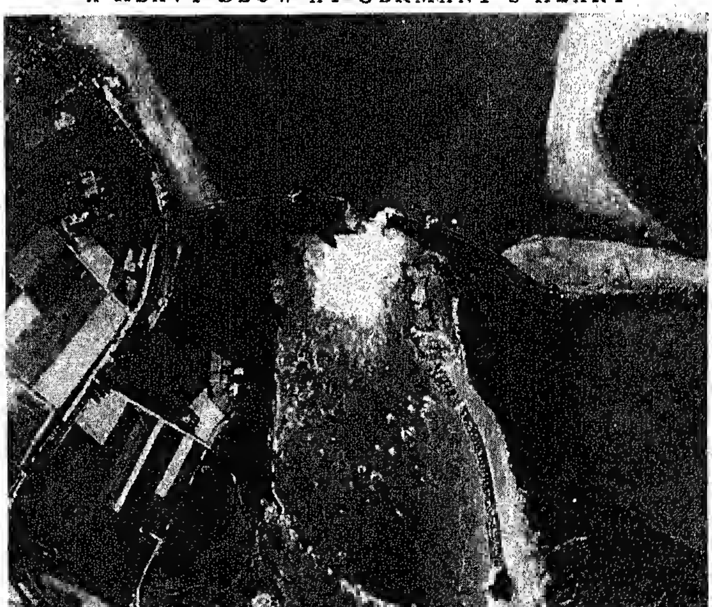
Immediately following the conclusion of that successful campaign, wave upon wave of Allied bombers had dumped thousands of tons of explosives on the Italian "nuisance" islands of Pantelleria, Lampedusa, and Linosa, off the Tunisian coast, until their bomb-shocked garrisons had surrendered in June. Then, with these minor strongholds overcome, the Allies had sent a 2,000-ship invasion fleet against Sicily on July 9. This force was under the supreme command of General Eisenhower, with British General Alexander as his deputy.

Preceded by paratroops and glider-borne troops, landings of men, tanks, guns, and supplies were made at two points on the island: by Americans in the vicinity of Gela on the southern shore, and by British and Canadians near Syracuse on the eastern coast. While the American troops, commanded by Lt. Gen. George S. Patton, fanned out to the west with their armored forces in the vanguard, the British and Canadians, under General Montgomery, captured Syracuse and then struck north toward the important port of Catania. Within two weeks the Allies had captured four-fifths of Sicily, including the capital of Palermo and more than 50,000 prisoners. About three more weeks of desperate fighting ended in the fall of the port of Messina, in the northeast corner of the island, on August 17. Thus in 38 days the Allies had disposed of a strategic Axis stronghold and had set the stage for the next move against Europe.

Mussolini Quits as Italian Leader

On July 25, in the midst of the Allies' conquest of Sicily, Benito Mussolini was forced to resign as premier of Italy. Thus his 21-year Fascist leadership came to an abrupt end at a time when further Italian participation in the war on the side of the Axis was beginning to be doubtful and extremely hazardous. King Victor Emmanuel appointed Marshal Pietro Badoglio to succeed Mussolini as head of a military government to continue the war. Upon assuming power, Badoglio tried to discuss terms of surrender with the Allies. But the presence of German troops in Sicily and southern Italy made it awkward for him to accede to General Eisenhower's demand that Italians cease at once all aid to the Germans.

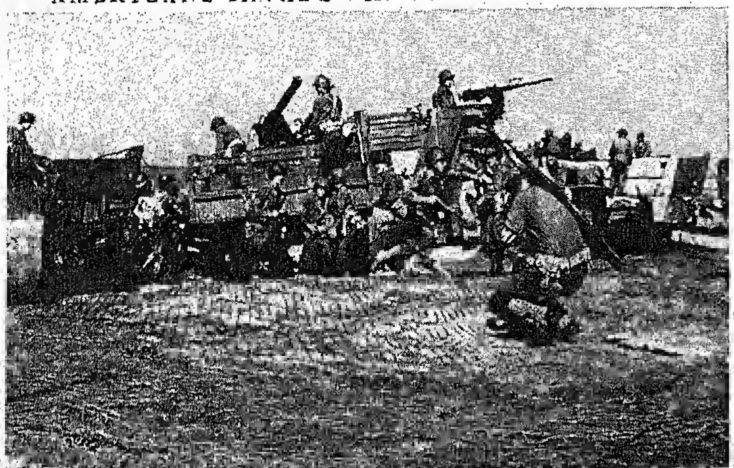
A HEAVY BLOW AT GERMANY'S HEART



In 1943, R. A. F. bombers breached the Mohne Dam in the Ruhr Valley in one of the most daring exploits of the war. Floods unleashed by 1,500-pound aerial mines engulfed towns, destroyed power stations, and uprooted railways.

Two days after the last Axis troops had fled across the Strait of Messina, United States and British warships joined heavy artillery and planes from Sicily in the swelling bombardment of the Italian mainland. Allied planes chased beaten Axis forces across the "toe" of Italy, bombing and machine-gunning them. Then a huge Allied air armada slashed at southern Italy's railroad and communication system in order to disrupt the enemy's defenses. Scores of American Flying Fortress and Liberator bombers struck the first blows August 20 at Foggia, key rail point about 20 miles inland from Naples. They loosed a torrent of 2,000-pound bombs that blasted freight yards, railway bridges, and warehouses.

AMERICANS INVADE THE ITALIAN MAINLAND



The top picture shows American soldiers dashing ashore under fire near Salerno. One of the men ducks instinctively as a shell screams overhead. Wire strips laid on the beach help the troops to maneuver on the sand. Below, having established the beachhead, infantrymen pursue the fleeing enemy inland past the ruins of an ancient temple in the vicinity of Naples.

Allies Storm Italian "Boot"

The raid on Foggia was but the open-gun in an Allied air barrage against military objectives up and down the entire length of Italy. The raids struck terror in the hearts of the Italian people, and chaos reigned in many cities as the populace began to realize the seriousness of the threat of invasion. Then early in the morning of September 3, the British 8th Army stormed across the Strait of Messina and landed in southern Italy. Rapidly the British widened their invasion zone by fanning out north and east along the Italian shore. In the face of this powerful Allied assault, Premier Badoglio's government surrendered its armed forces unconditionally September 8. This move knocked Italy out of the war as the partner of Germany, but the sizable Nazi forces still in southern Italy continued to offer stubborn resistance.

On September 9, the American 5th Army commanded by Lt. Gen. Mark W. Clark, in an attempt to get behind the enemy lines, hammered out a beachhead near Salerno, a few miles southeast of Naples. Simultaneously the British hurriedly "mopped up" the southern end of the Italian peninsula, capturing the Taranto naval base September 10 and the Adriatic port of Brindisi two days later. Then they struck north to join the Americans battling to hold off fierce German counterattacks at Salerno.

In a struggle more grim and bitter than any fought in North Africa or Sicily, crack German mechanized infantry and artillery doggedly tried to hem in General Clark's forces. The rugged terrain, in which the Germans held superior positions, further hampered the Americans' advance. On September 17, however, the British 8th Army joined the American 5th and together they smashed inland in the wake of a mighty aerial assault that stunned the Germans. The Foggia air base fell to the Allies on September 28, and this victory forced back the Nazis' left flank. Then on October 1, American and British armored columns moved into the burning city of Naples while the Germans scurried northward to take up new positions along the Volturno River. By October 18 the relentless Allied drive forced the enemy from their Volturno defense line positions, and a new battle line was formed across the whole peninsula some 90 miles below Rome.

Allied Attack Halted in Italy

During the latter part of 1943 and into the first quarter of 1944, the Allied attack in Italy was slowed down to a snail's pace both by bad weather and by battle-hardened German troops who fought bitterly for every yard of ground. The principal objective of

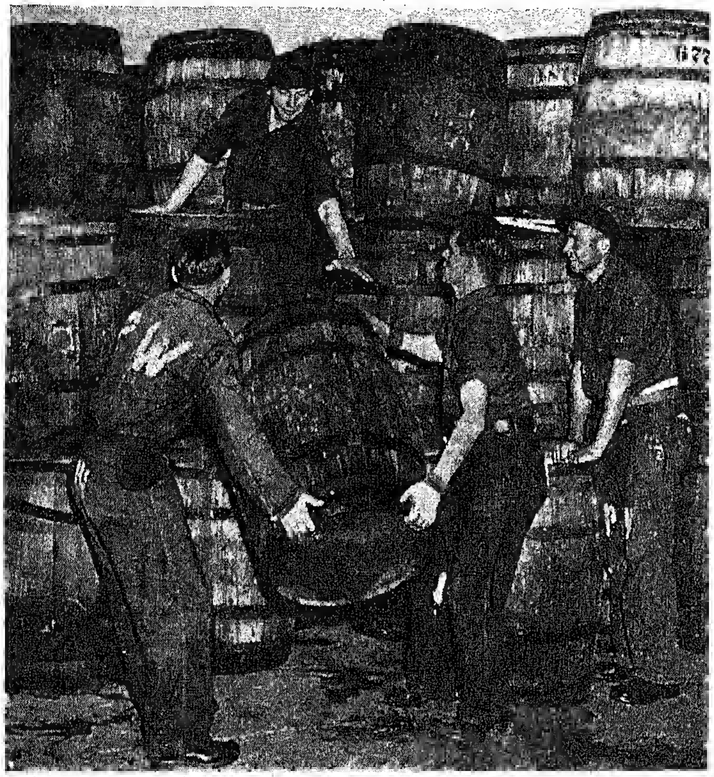
the Allies was the town of Cassino, a well-fortified point in the Germans' cross-Italy defense line. Cassino must fall if the Allies were to make headway in their advance on Rome. But for eight weeks—from January 25 through the first week in April—the German bastion held out despite repeated Allied air bombings and artillery barrages that pulverized the town.

In the hope of weakening the German position at Cassino, the Allies had landed January 23 at Anzio, behind the Nazi defense line and only 28 miles south of Rome. The Germans were caught off guard by this surprise maneuver, but they quickly rallied and threw savage attacks at the Allied invasion. Thus the Allies were unable to capitalize their early advantage and by mid-April they still were pinned down ineffectually to the beachhead. To some strategists the Allied campaign in Italy had almost the character of a defeat.

Balkans Revolt

In the latter part of 1943, the Balkans had become a battlefield for the Nazis. Rebellion was rampant in the entire region, and the military units stationed there were hard pressed to cope with the turbulent situation. The sorest spot was Yugoslavia, where fighting had never actually ceased since the German invasion in April 1941. By the fall of 1943, the guerrilla warfare of the previous two years had developed into large-scale operations under the leadership of two patriots. One was Gen. Draja Mihailovich, leader of the Chetniks. A rival faction, the Partisans, was commanded by Josip Brozovich, popularly called "Tito." The Partisans numbered about 180,000 and were more active than the Chetniks. In daring operations along the Adriatic coast, the former seized and temporarily held several vital seaports. They fought tank battles with the Germans in the vicinity of Trieste and Fiume, laid siege to towns garrisoned by Nazis, and ambushed troop and supply columns in the mountains.

GERMAN PRISONERS OF WAR LEND A HAND



Looking well fed and happy that their fighting days are over, these German prisoners of war interned at Camp Grant, Ill., help to store the Michigan grape crop. They are paid about 80 cents a day for this work, because an international agreement prohibits the "free" labor of prisoners of war.

Besides their Balkan troubles, the Germans suffered a blow to their waning sea power December 26. On that date British warships sank the 26,000-ton battleship *Scharnhorst* in an Arctic Ocean engagement off North Cape, Norway. The German ship had attacked an Allied convoy to Russia guarded by the battleship *Duke of York* and several cruisers and destroyers.

War Planning and Diplomacy

In 1943 President Roosevelt and Prime Minister Churchill met several times to formulate plans for Allied military moves against the Axis. Their first meeting was at Casablanca, French Morocco, in January. In May they conferred at the White House, and their third parley took place at Quebec in August. On these three occasions they drew up the "blueprint" of Allied operations designed to force the Axis into "unconditional surrender." Then in November and December of 1943 two more war strategy conferences were held. The first was at Cairo, Egypt, between Roosevelt, Churchill, and Chiang Kai-shek. They vowed to strip Japan of all its ill-gotten gains after its defeat. The second meeting followed immediately at Teheran, Iran, where the long-awaited conference between Roosevelt, Churchill, and Stalin set the "zero hour" for opening a second front in Europe.

There were other events of diplomatic significance during 1943. In May the dissolution of the Russian Communist International had been acclaimed as a stroke that would tighten Allied postwar bonds. Then in June the rival leaders Giraud and De Gaulle had formed a French Committee of National Liberation to act as the trustee of French interests abroad until a government should be set up after the homeland was freed. On December 12 Russia and Czechoslovakia signed a 20-year mutual assistance pact with the aim of establishing close postwar coöperation between the two nations. On the same day Brazil became the first Latin American country to take an active hand in the

war when it announced that it would send an expeditionary force to serve with Allied troops overseas. The climax of Allied military planning for 1943 was reached December 24 with Roosevelt's announcement that American Gen. Dwight D. Eisenhower would command the impending Allied invasion of Europe.

Diplomatic Events of 1944

In January, as her armies entered Poland, Russia announced her intention of setting up the postwar Soviet-Polish border along the 1919 "Curzon line." The Polish government in exile was incensed by this plan, and asked the British and United States governments to arbitrate the boundary dispute that intensified the already strained relations between Russia and Poland. Then early in February, Russian diplomacy scored what many observers believed was a strategic gain when Stalin announced that autonomy in foreign relations was granted the 16 member republics of the Soviet Union—a move that was expected to give Moscow great postwar bargaining power.

Meanwhile in the western hemisphere, Argentina had finally broken diplomatic ties with Germany and Japan on January 26 after discovering an extensive Axis espionage network within the country. Then the scene shifted again to Europe as peace negotiations were discussed spasmodically by Russia and Finland during February and March. The Finns rejected the Russians' original armistice terms as too harsh; but when the Russians modified them in April, it appeared that the Finns might accept them and soon drop out of the war.

Getting Ready for the Peace

ALMOST as soon as the second world conflict had begun to evolve into its larger phases—and while the Axis countries were stunning the world with their early conquests—leaders of the principal opposing nations had started to formulate proposals for assuring a lasting peace after the ultimate defeat of the aggressors. In fact, even before the United States entered the war, the cornerstone of the world peace structure had been laid.

The "Atlantic Charter"

To COÖRDINATE the British and American war efforts, to unite the people of Europe and of the entire world against the Nazis, and to lay the basis for an ultimate and lasting peace, President Roosevelt and Prime Minister Churchill had held a dramatic series of meetings on the sea off the North American coast during the second week of August 1941. They were accompanied by high military and civilian officials of both the United States and Great Britain.

From this so-called "Atlantic Conference" resulted the historic declaration known as the "Atlantic Charter" signed by the President and the Prime Minister, in which they stated the eight principles "on which they base their hopes for a better future for the world":

First, their countries seek no aggrandizement, territorial or other;

Second, they desire to see no territorial changes that do not accord with the freely expressed wishes of the peoples concerned;

Third, they respect the right of all peoples to choose the form of government under which they will live; and they wish to see sovereign rights and self-government restored to those who have been forcibly deprived of them;

Fourth, they will endeavor, with due respect for their existing obligations, to further the enjoyment by all States, great or small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity;

Fifth, they desire to bring about the fullest collaboration between all nations in the economic field with the object of securing, for all, improved labor standards, economic adjustment, and social security;

Sixth, after the final destruction of the Nazi tyranny, they hope to see established a peace which will afford to all nations the means of dwelling in safety within their own boundaries, and which will afford assurance that all the men in all the lands may live out their lives in freedom from fear and want;

Seventh, such a peace should enable all men to traverse the high seas and oceans without hindrance;

Eighth, they believe that all of the nations of the world, for realistic as well as spiritual reasons, must come to the abandonment of the use of force. Since no future peace can be maintained if land, sea, or air armaments continue to be employed by nations which threaten, or may threaten, aggression outside of their frontiers, they believe, pending the establishment of a wider and permanent system of general security, that the disarmament of such nations is essential. They will likewise aid and encourage all other practicable measures which will lighten for peace-loving peoples the crushing burden of armaments.

The Four-Nation Declaration

Atop the cornerstone of the Atlantic Charter another stone was added in 1943 to the postwar peace foundation being laid while the war was in progress. On October 19–30, American Secretary of State Hull, British Foreign Secretary Eden, and Russian Foreign Commissar Molotov met in Moscow to outline a plan for concerted action by the three great powers and China during the war and in the peace to follow. The deliberations produced the Joint Four-Nation Declaration, signed by the three conferees and the Chinese ambassador to Moscow.

The pact expressed the determination to carry out a coöperative program that embraced: (1) the prosecution of the war to the complete subjugation of the Axis nations; (2) the regulation of postwar armament; (3) the establishment of an international organization to maintain peace and security, in which all the other United Nations would be asked to participate; (4) a pledge of the continued united action of the four powers after the war; (5) punishment of Axis war criminals by their victims.

The agreement cleared the atmosphere of uncertainty about Russia's willingness to be a coöperative postwar partner. In the opinion of many, however, the conference's failure to discuss Russia's previously announced postwar intention to annex the Baltic states and eastern Poland dissented from the principles of

SIGNING THE FOUR-NATION DECLARATION IN MOSCOW

This picture records the historic signing of the Moscow pact in October 1943. Seated left to right are Fu Ping-Sheung, Chinese ambassador to Russia, United States Secretary of State Cordell Hull, Russian Commissar of Foreign Affairs Vyacheslsv Molotov, and British Minister of Foreign Affairs Anthony Eden.

the Atlantic Charter relating to the self-determination and self-government of nations.

Additional Peace-Planning Conferences

As already mentioned, two other historic meetings of Allied leaders took place at Cairo and Teheran late in 1943. Although the conferences dealt in part with military plans for subduing the Axis as quickly as possible, additional plans for securing the postwar peace also resulted from the discussions.

The Cairo sessions of November 22–26 between Roosevelt, Churchill, and Chiang Kai-shek produced detailed plans for the ultimate fate of Japan. The three leaders agreed that (1) Japan must give up all the conquests it had gained by aggression since 1853; (2) Manchuria, Formosa, and all other territories taken from China must be restored to the Chinese; (3) Korea must be made a free and independent state.

From Cairo, Roosevelt and Churchill went at once to Iran, where their conferences with Stalin from November 28 through December 1 mapped a peace that it was hoped would endure "for many generations." The joint declaration released after the parley reflected the cordiality and complete agreement of the three men and invited all freedom-loving nations "to come into a world family of democratic nations."

Providing Postwar Relief for War Victims

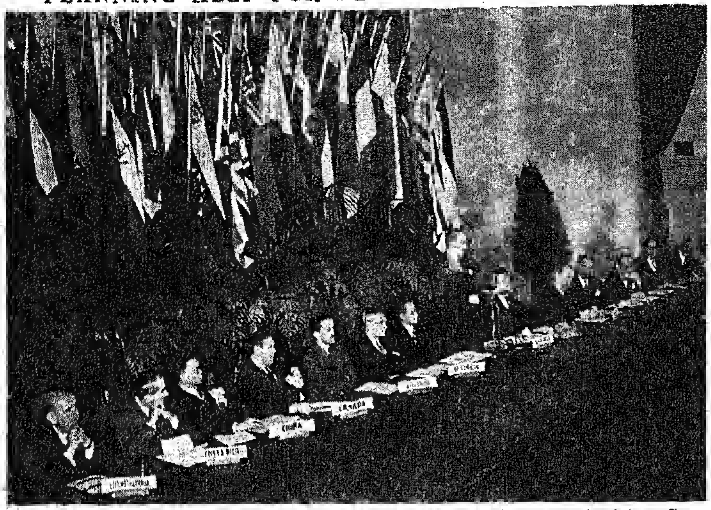
Because so many countries were devastated by the war, the world was faced with the prospect of millions of people in those nations being unable to feed and clothe themselves adequately when the war ended. It was decided, therefore, that the needs of those unfortunate people must be met by the nations who could spare the required supplies.

To provide the greatest amount of aid, the United Nations Relief and Rehabilitation Administration was established. On November 9 representatives of 44 United Nations and those associated with them met at the White House and signed the agreement creating the organization. The next day the delegates convened at Atlantic City to set up the procedure for furnishing and allocating the relief. They chose as director-general the American nominee for the post, former Governor Herbert H. Lehman of New York, who had headed the American Office of Foreign Relief and Rehabilitation.

It was estimated that European countries in the first six months after the war would need approximately 46 million tons of food, seed, fuel, clothing, medical supplies, raw materials, and machinery. The plan of paying for the relief contemplated assessing the participating nations a certain percentage of their national income. The total fund would amount to about 2 billion dollars, of which the United States would furnish 1 billion 350 million dollars. Congress on March 22, 1944, authorized that amount as the American contribution. In the administration of the relief, each member nation had one vote—a feature sharply criticized by some American leaders in view of the nation's disproportionately large contribution.

To coöperate with the United Nations Relief and Rehabilitation Administration in relief work, President Roosevelt on Jan. 22, 1944, had set up the War Refugee Board. It was comprised of Secretary Hull, Secretary Morgenthau, and Secretary Stimson. Its function was . . . "the development of plans and programs . . . for (a) the rescue . . . and relief of the vic-

PLANNING HELP FOR DEVASTATED COUNTRIES



Standing before the grouped flags of the United Nations, American Assistant Secretary of State Dean Acheson addresses a session of the United Nations Relief and Rehabilitation Administration conference in Atlantic City. Delegates from 44 countries formulated plans to aid the people in war-torn lands.

tims of enemy oppression" and "(b) the establishment of havens of temporary refuge for such victims."

Plans for Stabilizing World Currency

It was recognized shortly after America's entry into the war that it would be advantageous to devise some means of stabilizing the currencies of the various nations to obviate the possibility of financial chaos in the postwar period. Two proposals for accomplishing that end were advanced during 1943.

One plan was advocated by John Maynard Keynes, famed economist and adviser to the British Treasury. The other was suggested by Harry D. White, monetary adviser to the United States Treasury. The plans were similar in their general outline, each having as its aim the establishment of an international currency—called "bancor" in the British proposal and "unitas" in the American version—which would be the medium of exchange for postwar international trade. The plans differed, however, in the matter of how the world currency should be set up and how much of it each nation would be entitled to have.

The British plan would set up an International Clearing Union from which countries in temporary need of funds to finance international trade could borrow. The amount of the world currency a nation would be allowed to borrow would be determined by the volume of that nation's foreign trade in three prewar years. The American plan, on the other hand, would set up an International Stabilization Fund amounting to 5 billion dollars contributed by the participating nations. Each nation would contribute to the fund a "quota" based on the amount of its gold, foreign exchange, and its national income. A nation in need of financial aid could borrow from the fund an amount equal to its contribution.

A ramification of the American proposal envisioned the establishment of a 10-billion-dollar international bank called the United Nations Bank for Reconstruction and Development. Designed to lend money to aid in the rehabilitation of member nations, the bank would do so only when a nation could not borrow private funds through normal investment procedures. This plan was expected to form one basis for discussion of the whole currency stabilization idea at a conference presumably to be held early in 1944. Many people viewed the several monetary proposals as springboards for launching more extravagant plans for a super world government.

Proposed World Organizations

Several theories were advanced, in fact, relating to the reorganization of the world's nations after the war so mankind would not again suffer the ravages of war. One such plan, labeled "Union Now," was advocated by an American, Clarence K. Streit. His proposal was widely discussed and favored by many people. He would have 15 nations—the United States, Great Britain, Canada, Australia, New Zealand, Union of South Africa, Ireland, France, Belgium, the Netherlands, Switzerland, Sweden, Denmark, Norway, and Finland, with a total population of about 280 million—join together in a union similar to the American Union. Other countries would be admitted whenever they "qualified" by adopting the union's bill of rights. Each citizen of the member nations would be a citizen of the union, just as each citizen of the 48 states is a citizen of the United States. The new gigantic nation would have power to frame the union's foreign policy, but each nation would retain control of its internal affairs. A common army and navy would insure military supremacy for the union and keep aggressor nations in check. The union would possess prodigious economic, industrial, and trade resources. It was asserted that, because the proposed organization would be a *union of people* rather than an alliance or league of states, the binding quality of its "nationalism" would give rise to a new world order, founded on coöperation and understanding, that would foster a secure and lasting peace.

Another world organization to preserve peace was that suggested by Prime Minister Churchill. In an address delivered March 21, 1943, he proposed to establish a "world institution embodying or representing the United Nations, and some day all nations." Supplementing the top institution would be a "Council of Europe" and a "Council of Asia." He also implied that a "Council of the Western Hemisphere" might be set up along the lines of the existing Pan American Union, which had behind it years of accomplishment in preserving peace in the American continents.

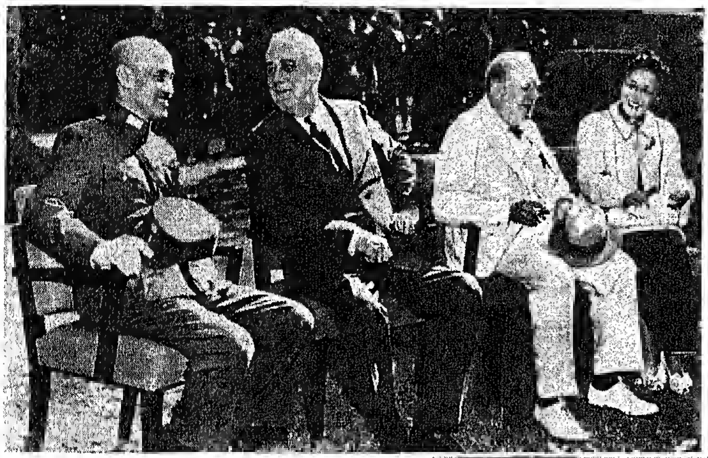
Churchill believed that the chief responsibility for maintaining peace should rest in the regional councils; they should create the machinery for set-

tling controversies and provide the armed forces to suppress aggression. If a dispute in a regional council threatened to get out of hand and exceed the council's ability to cope with it, the "world institution" would set in motion its conciliation and enforcement procedures to settle it and prevent its growing into a world-wide conflict.

Akin to Churchill's concept of a European council of nations was a plan advocated Nov. 25, 1943, by Field Marshal Jan Smuts. His proposal stated that, whereas only two powers likely would dominate Europe after the war—Great Britain and Russia—Great Britain should strengthen her position by inviting smaller European nations into the British Commonwealth, thereby creating a great state to divide with Russia the responsibility for guiding Europe's future destiny.

A third world security proposal, somewhat similar to Churchill's, was termed the "World Federation Plan." It called for dividing the nations of the world into regional federations, which in turn would comprise a world federation just as the Swiss cantons make up the Swiss Confederation. Each regional federation would keep its own sovereignty but would coöperate with the others if the security of any one of them was threatened. The units of the world federation would be the American, British, Latin-European, Chinese, Germanic, Middle-European, Russian, Middle-Eastern, Japanese, Malaysian, and Indian federations. Every nation, including Germany and Japan, would be permitted to have an army of its own, but these armies would have only small arms at their disposal. The real enforcement agency would be an international police force recruited from the citizens of all the regional federations but owing allegiance solely to the world federation.

PLOTTING AXIS DOOM—AND THE PEACE TO FOLLOW



In the top picture are shown Chiang Kai-shek, President Roosevelt, Prime Minister Churchill, and Madame Chiang Kai-shek. In a momentous meeting at Cairo, Egypt, these Allied leaders agreed on plans to beat Japan into total submission. Below, Premier Stalin, Roosevelt, and Churchill after their historic conferences at Teheran, Iran. Stalin wears a marshal's uniform, and Churchill is garbed in the uniform of an R. A. F. marshal.

The concept of a "world police force" was prominent in each of these three plans. American Secretary of State Hull likewise advocated a world court whose authority would be upheld by armed might to force all nations to live as good neighbors. The question of whether or not a truly international force should and *could* police the world after the war was argued pro and con. Just how far each nation would be willing to go in surrendering a part of its sovereignty to a world governing body was problematical and incapable of being ascertained until peace was actually attained. Most people were agreed, however, that the future peace of the world would depend on the continued coöperation and national "good sense" of the dominant nations.

Other Postwar Problems

In addition to the peace plans already discussed, many more questions difficult to answer were posed and debated as the war's finish began gradually to come into view. Would the United States and Britain become peacetime rivals for world supremacy along the international air routes certain to be extended when hostilities ceased? How should the United Nations deal with a conquered Germany? Should the Reich be dismembered and its young people reëducated? How much of the great merchant fleet built by the United States during the war could be kept moving through peacetime trade channels? In what way should the surpluses created by war production be released for civilian purposes? How could all the nations of the world be given equal access to the earth's minerals,

as assured by the Atlantic Charter? What would be the peacetime fate of war industries; could they be reconverted to civilian uses? These and many other problems defied immediate solution. But the future held the promise that practical answers would be forthcoming when there was actual need for them.

—REFERENCE-OUTLINE *for Study of* UNITED STATES AT WAR—

THIS OUTLINE is designed to help in the study of the second World War from the special point of view of American participation. References covering the general progress of the war will be found in the Outline for Current Events, pages H-310*a–f*.

The Fighting Front

I. EVENTS LEADING TO WAR: P-10, R-146*p*, W-178*v*.
A. Aggressive Policy of Japan: J-192, P-10, W-178*m*.
B. Axis Attacks on U. S. Ships: R-146*p*, W-178*t*.
II. OUTBREAK OF WAR: N-12*e*, R-146*p*, W-178*v*.
A. Surprise Attack by Japan: J-192, W-178*v*, pictures W-178*w*, N-12*c*.
B. Germany and Italy Declare War: W-178*w*.
C. Latin America Supports United States: W-178*w*.
III. MILITARY AND NAVAL EVENTS: W-178*v*-179*e*.
A. American Troops Go to Battle Stations: N-12*e*.
B. Pacific Outposts Lost: Guam G-181; Wake Island W-2; Philippines W-178*x*.
C. MacArthur in Command in Australia: M-1, W-178*y*.
D. First American Victories: Coral Sea W-178*y*; Midway Island W-178*y*; Bismarck Sea W-178*y*.
E. United States Recaptures Aleutians from Japanese: W-178*y-z*.
F. Americans Go on Offensive in Pacific: W-178*y-z*, W-179.
G. U. S. Airmen Raid Germany: W-179*c*.
H. Americans Take Sicily; Invade Italy: W-179*d–f*.
IV. DEFENSE OUTPOSTS OF THE UNITED STATES:
A. Panama Canal Defenses: C-84, P-41–2, N-51–2, W-72*e*, maps N-52, W-72*b–c*.
B. Pacific Outposts: P-8–9, maps P-10*b–c*, pictures P-10*d*.
C. Outposts Acquired under Defense Program:
  a. In American Territory: Alaska A-107.
  b. Leased from Great Britain: N-52, R-146*n*, W-178*m*.
  c. Obtained by Occupation (Greenland and Iceland): R-146*p*, W-178o.
V. ORGANIZATION OF THE ARMED FORCES OF THE UNITED STATES: N-12*i–j*, R-146*p*.
A. Organization of the Army: A-306, U-224.
  a. Air Forces: A-306–7; Ground Forces: A-307–307*c*; Army Service Forces: A-307*a–b*.
  b. Personnel and Rank: A-307*d*.
B. Organization of the Navy: N-51, N-56*b*, U-226.
  a. The Fleet and Its Armament: N-53–56*a*; Shore Establishments: N-56*b*; Personnel: N-56*f*; How Ships Are Named: N-56*a*.
  b. Compared with Other Navies: N-56*f*.
C. The Marine Corps: M-65.
D. The Coast Guard: C-289.
E. Women's Auxiliary Services: N-12*j*.
F. Uniforms and Insignia: U-177–81.
  —Army U-180–1, pictures U-178; Marine Corps U-180; Navy U-180–1, pictures U-179.
G. Decorations of Honor: D-31–2.
VI. ARMAMENT: Airplanes A-74*a*, A-306–7; Antiaircraft Artillery A-307; Garand Rifle F-51; Machine Guns M-6–9; Tanks A-307*b*, T-9; Torpedoes T-113–14.

The Home Front

I. HOW THE NATION STOOD AT THE ONSET OF WAR: N-12*c–d*.
A. Supply of Raw Materials: N-12*d*. Aluminum A-138; Guayule G-181*d*–182; Manganese M-53; Rubber R-168.
B. Machines and Armament: N-12*d*, picture N-12*e*. Airplanes A-74*a–d*; Navy N-56*f*, R-146*p*.
C. Early Appropriations for Defense: N-12*d*, graph N-12*f*.
D. Growth of Manpower: N-12*d*, R-146*n*, V-315.
II. UPSURGE STARTED BY WAR: N-12*e*.
A. Reorganization of the National Government: N-12*e*, U-232.
B. Swift Rise of War Production: N-12*g*.
  a. Allocations and Priorities: N-12*f*.
  b. Conversion of Industries: N-12*f*.
  c. Cutting Civilian Production: N-12*g*.
C. Transportation by Land and Sea: N-12*g–h*.
  a. Railroads Do Remarkable Job: N-12*h*.
  b. Tremendous Need for More Ships: N-12*h*.
D. Mobilizing Nation's Full Supply of Manpower: N-12*i–j*.
  a. Meeting the Army's Needs: N-12*i*, R-146*p*.
  b. Meeting Industry's Needs: N-12*j*.
  c. Increased Employment of Women: N-12*j*, *r*.
  d. Status of Union Labor: N-12*j*.
  e. Shortage of Housing: N-12*k*.
E. Work of the Nation's Schools in Wartime: N-12*k*.
  a. Training for Technical Work: N-12*k*.
  b. Other Educational Measures: N-12*l*.
  c. Defects in Peacetime Training Revealed: N-12*l*.
III. EFFECT OF WAR ON CIVILIAN LIFE: N-12*l–p*.
A. Organization of Civilian Defense: N-12*m*.
  a. Control Centers and Blackouts: N-12*m*.
  b. The Red Cross at Work: N-12*m*, picture R-61.
B. Precautions against Spies and Sabotage: N-12*n*.
  a. Handling of Enemy Aliens: N-12*n*.
  b. Keeping Wartime Secrets: N-12*n*.
  c. How Censorship Is Organized: N-12*n*.
C. Office of War Information: N-12*n*.
D. War Rationing: Nation Registers for Ration Books N-12*o–p*; Rubber, Gasoline, Fuel Oil, and Food Rationed N-12*n–p*.
E. Economic Stabilization: Director Appointed to Control Wages and Prices, Including Farm Prices N-12*p–q*.
IV. MEETING THE COSTS OF WAR: N-12*q*.
A. Mounting Appropriations: N-12*q*.
B. Huge Tax Increases: N-12*q*.
  a. Plans for New Taxation: N-12*q*.
  b. Campaign to Sell Bonds: N-12*q–r*.
  c. Pay-as-you-go Tax Plan: N-12*q*.
C. War Budget for 1944-45: N-12*r*.
V. GROWING MANPOWER PROBLEMS: N-12*r*.
A. Labor Shortages and Strikes: N-12*r*.
B. Coördination of War Agencies: N-13.

WORMS. All long, narrow, creeping, or squirming lower animals are "worms" according to general popular conception. We speak of earthworms, tapeworms, "cutworms," "cabbage worms," "wireworms," and many others. Only the first two of these, however, are true worms, the others being the early stages or larvae of moths, butterflies, and beetles. Earthworms and their relatives belong to the higher or ringed worms (*see* Earthworms).

The lower worms—the *Vermes* of the zoölogist—as treated of here, include about 9,000 known species or kinds of extremely diverse animals that are often divided among a half-dozen independent branches of the animal kingdom. Among them are a thousand shapes and sizes. Many are long and worm-shaped; but many of them also are short and flat, while some look more like seaweeds, and some have bivalve shells. Some are invisible to the naked eye; some of the tapeworms are 30 feet long.

Among them are also a thousand places and modes of life. Many of them live in fresh or salt water, in the soil, or in decomposing organic matter. A majority are parasites in a great variety of animals and some plants. They lead strange lives, and some of them have the most curious and wonderful life histories of all animals. Many of them cause diseases of man and domestic animals and plants. In most cases the injury is but slight. They are soft-bodied, except one group (the Brachiopoda) that have bivalve shells, and another group (the Bryozoa) that look more like seaweeds. The *flatworms* and *roundworms* are of greatest interest and practical importance, and will be treated of more fully.

The flatworms are oftenest leaf-shaped, though the tapeworms are long and narrow. Except the tapeworms, flatworms have a mouth, but no intestinal opening; waste is discharged through the mouth. A majority are parasites and show strikingly the degeneracy resulting from their parasitic life. A tapeworm of man, for instance, lives in the intestine surrounded by digested foods, ready for its absorption. It no longer has to "hustle" for itself, and so has lost its organs of special sense, its organs of locomotion, even its mouth and digestive system. Parasites are also oftenest hermaphrodite, that is, bear both male and female sex cells.

Remarkable History of the Liver Fluke

The liver fluke illustrates well the mode of life and wonderful histories of the flukes. It lives in the gall passages, oftenest in the sheep, but also in cattle, rarely if ever in man. It is leaflike in shape, about an inch or two long, a half-inch wide. When a hundred or more of them infest a sheep they cause liver rot and death of their host. Formerly, especially in Great Britain and Ireland, millions of sheep were lost in bad years. The life history is so surprising that one would not believe it possible if scientists had not worked it out with great ingenuity and patience, and with very great benefit to sheep raisers. Each full-grown worm produces about a half-million eggs which pass out of the sheep's body with the intestinal waste. If an egg falls into water of the proper temperature, it hatches out into a kind of tiny microscopic larva which swims about and bores its way into the soft body of a certain kind of common pond snail. Here it grows and forms on its inside a dozen or two larvae of a second type; each of these, still inside the snail, produces a dozen or two larvae of a third kind, tadpole-shaped. These break out from the snail, swim about, and cement themselves to blades of grass which are eaten by sheep. They pass from the intestine up the gall passages and, in a few months, grow to full size. Amazing as is this life history of the liver fluke, it becomes still more complicated under certain conditions. Fortunately, liver flukes are found in only a few limited localities in the United States—parts of Texas, Florida, etc. Drainage of marshy places and other devices are effective in killing the snails and getting rid of the flukes. There are about 2,500 known kinds of flukes, all parasites in many kinds of animals. About a quarter are external parasites of water animals, mostly fishes, and have but a single host. Some of them have even three hosts in their life history. The liver fluke just described is the only very bad one.

The History of the Tapeworm

The commoner "beef tapeworm" of man will typify the several thousand kinds of tapeworms that infest almost all of the backboned animals of all kinds. It lives attached to the inside lining of the small intestine. The name suggests its general form. It is soft, whitish, narrow, and very long—up to 30 feet in very large specimens. The "head," about the size of a large pinhead, has four suckers for attachment to the intestine. Back of the head is the "neck," in size and form much like grocer's twine. It gradually enlarges away from the head, and becomes jointed till the larger free end is composed of joints over a half-inch long and a quarter-inch wide. The joints are maturing all the time and are cast out, singly or a few at a time, with the intestinal waste. Each bears both kinds of sex cells and is really an animal, so that a tapeworm really seems to be a chain of more than a thousand animals. The eggs enter cattle by water or food and hatch into tiny larvae which burrow through the wall of the intestine to the blood stream. They pass to the muscles where they grow into bladder worms, coiled up and about the size of a pea. The presence of these gives the name of "measly beef" to the meat. This meat, improperly cooked, infects man. The little worms attach themselves and grow to full size in a few months. One large worm would seem to be bad enough, but sometimes there are two of them. Other tapeworms of man are the "pork tapeworm" about 9 feet long, from eating measly pork, and the "fish tapeworm," from measly fish, up to 25 feet long. The two last are found mostly in Europe, seldom in the United States. Other kinds of tapeworms, some of them in man, have life histories even more striking but more difficult to understand.

A person treated for tapeworm fasts for a day; then takes some poison that causes the worm to loosen its hold, followed by castor oil to sweep the intestine clear. It is necessary for the head of the worm to be loosened, otherwise the whole worm will grow again. Tapeworms are really not of much danger, for they are not frequent, and a person has but slight chance of becoming infested.

The names "threadworms" and "hairworms" for different kinds of roundworms suggest their long narrow form. They move by squirming; are oftenest a whitish color; never jointed; vary in size from a hundredth of an inch long to more than a yard; are of separate male and female sexes, the female almost always being the larger; and the young are often born alive. Several thousand species are known. Many of them live in water of ponds and streams, or in the soil of gardens, or in decomposing organic matter. Most of them, however, are parasites which live in all sorts of backboned animals, and in many of the lower animals, especially insects of many kinds. They are the commonest parasitic worms of man and domestic animals. Many of them pass their early life in one host and their adult life in another.

Only a brief account of a few of the most interesting and important forms can be given here. The tiny "vinegar eel" may typify the free-living form. It is about a twelfth of an inch long and grows in vinegar and other fermenting fruit juices. Surprising forms are the "hairworms," five or six inches long, that live coiled up in the bodies of grasshoppers, caterpillars, and other insects. The "horsehair worms," a foot to a yard long, also develop in insects. They break out, sometimes in horse troughs and streams, and give rise to the mistaken notion that they come from horsehairs. Of course no one has ever really known of a horsehair turning into any living animal!

Among the strangest of the life histories are those of the *filarias*. This worm is conveyed to man by mosquitoes, much as malaria germs; it is three inches long, and a hundredth of an inch in diameter. It is one of the causes of "elephant skin" or elephantiasis in man, in which a leg may grow almost as large as the rest of the body. Another filaria, the "Guinea worm," is a yard long, lives coiled up in the skin, and enters the body through fleas in drinking water.

Cause of the Dread Trichinosis

The disease trichinosis of man is caused by a small worm (*trichina*) a tenth of an inch long. The natural home of the full-grown worm seems to be in the intestine of the rat. Eaten by pigs, the young hatch out and pass in the pig's blood stream to its muscles, where they develop into "encysted" or coiled-up larvae, ready to be eaten by man. Poorly cooked pork passes them alive to man, where they develop rapidly in the intestine; and the young then pass to the muscles, and become coiled up, sometimes by millions. Only the smaller part of cases of trichinosis result in death. Government inspection of pork makes the danger of infection very slight.

One of the most notorious of the roundworms is the "eelworm" so prevalent among children, but found also in pigs, as a parasite of the intestine. Infection is from water, fruit, etc. It grows to be 8 to 12 inches long. The eggs pass out with the waste, and develop in the water or soil, ready to infect other people. Very similar is the "mawworm," from the intestine of the horse; when abundant it has been known to cause death.

The worst of all the worm parasites of man—among the greatest of the enemies of mankind—are the two species of "hookworms" so prevalent in warmer countries. They infest perhaps a quarter of mankind at the least (*see* Hookworm).

They Might Be Much Worse!

These are just a few of the many interesting and important worm parasites that infest man and domestic animals. While the number is very large, and their injury sometimes great, it is comforting to know that most of them are local in their distribution and unusual. None of them except hookworms compare in importance with the worst of the microscopic disease germs, both plant and animal. Almost all may be easily avoided by proper habits of life—clean surroundings; clean, dry, light houses; proper care of the water supply; proper cooking of foods. Civilized man, leading a hygienic life under sanitary conditions, is seldom attacked.

The "worms" as a general term include both the lower worms treated of in this article, and the ringed or segmented worms or *Annelida*. The *Vermes* of the scientist—the "worms" as used here—is sometimes considered one of the great branches of the Animal Kingdom; but it is oftener broken up into four or five minor branches of animals. (*See* chart accompanying Animal Kingdom.) The *Rotifera*, or "wheel animalcules," are small microscopic forms, the largest of the thousand known species being not over a twelfth of an inch long. They hook themselves fast by a pair of hooks, and have a "wheel" of cilia around the free end, whence the name "wheel animalcules." They are mostly fresh-water forms and are among the most omnipresent and fascinating of the many kinds of "animalcules" for microscopic study. The *Bryozoa* or "moss animals" look much like seaweeds and mostly live as colonies. They are found as very ancient fossils, and as living forms in both fresh and salt water; some fresh-water types form large jelly-like masses, a foot in diameter. The *Brachiopoda* or "lamp shells" are attached, marine, mollusk-like worms, with a bivalve shell. The two valves are not right and left as in a clam, but upper and lower. These forms evolved early in the world, and all of the almost 3,000 known species are fossil, except about 120 species. Some of the living kinds are among the oldest known animals, for they have remained practically unchanged since early geological times—for many millions of years.

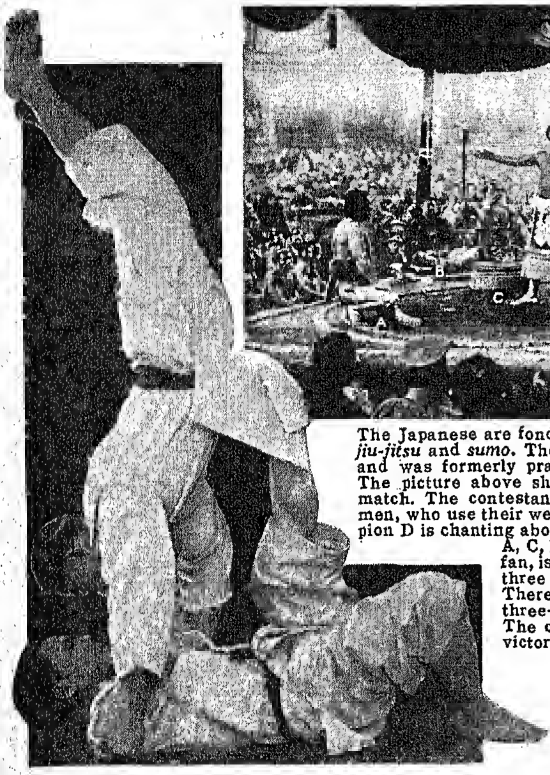
WREN. "The little chattr'n sassy wren, no bigger'n my thumb," as 'Darius Green' characterized the house-wren, is a world-wide busybody. Her large family appears in over 250 different species, but always as small birds in quiet grayish-brown feathers. The sexes are alike, not only in dress but also in manner. They are never quiet and usually appear nervously excited, with tail carried erect and shining eyes spying into every corner. When displeased the wren utters a loud insistent scolding call.

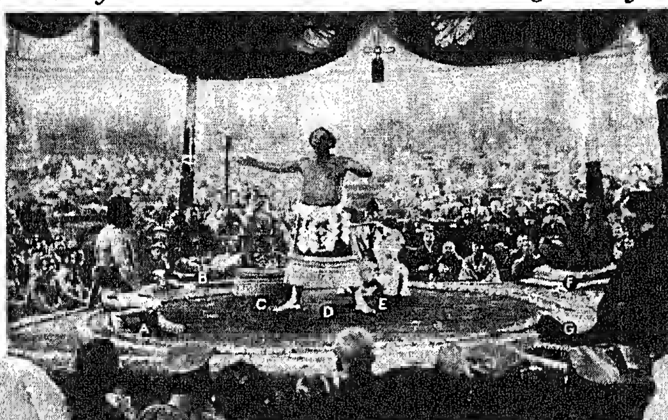
The many species build similar dome-shaped nests in trees or rock-cavities or in nooks about a barn or house. The white or pinkish spotted eggs are from 6 to 11 in number, and as each pair of wrens rears two families each season, the parents are necessarily great foragers and take heavy toll of garden insects.

All wrens are famous singers. No member of the family has been accused of harm to man, and no wild birds live on more intimate terms with their human neighbors. About 9 species are found in the United States. Of these the house-wren is best known. (For illustration in colors, *see* Birds.) The marsh wren is remarkable for his night song which on moonlight nights may be heard from dusk till dawn. The cactus wren of the western United States is the largest of the American wrens. It is about 9 inches in length. The wrens form the family *Troglodytidae*. Scientific name of house-wren, *Troglodytes aëdon*.

WRESTLING—*The Ancient Test of* SKILL *and* STRENGTH

How Men Have Developed the Science of Wrestling from Prehistoric Times—From the Friendly Tussle to the Serious and Dangerous Jiu-jitsu





The Japanese are fond of two forms of wrestling—*jiu-jitsu* and *sumo*. The latter is over 2,600 years old and was formerly practised only by the nobility. The picture above shows the setting for a sumo match. The contestants are extraordinarily heavy men, who use their weight scientifically. The champion D is chanting about his prowess, while friends, A, C, look on. The man E, with the fan, is referee; only descendants of three families may fill this post. There are four observers, but only three—B, F, and G—are shown. The champion's sword, symbol of victory and the spirit of fight, is carried by friend C.

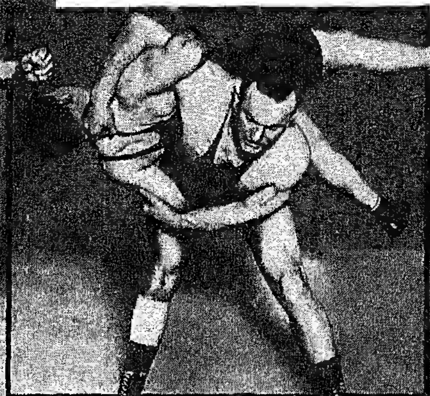
In judo—we call it "jiu-jitsu"—a small man uses a larger adversary's weight against him, as the pictures on left and right show. In each, the upper man is in for a nasty fall.

WRESTLING. A boy's first and most natural sport, and the sport of all nations since the beginning of time, is wrestling. The small youngster, hardly able to walk, enjoys tussling and grappling with brother or sister or with the family dog or cat. Homer sang of a great wrestling match in which Odysseus defeated Ajax for the shield of the slain Achilles. The throne of Japan was the prize in a match between two sons of the Emperor Bantoku, in 858; Koreshito won and ruled as Emperor Seiwa. Egyptian pictures dating perhaps 3,000 years B.C. picture wrestling scenes, showing almost all the "holds" we know today. Wrestling was a feature of the games of ancient Greece to which we trace our present Olympic games. Wrestlers of old often rubbed oil and fine sand on the body, to avoid offering a hold for the foe.

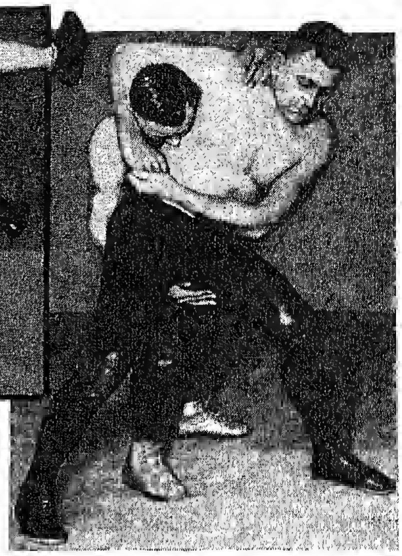
Wrestling is an excellent exercise, since it brings almost all the muscles into play. It is a useful sport too, for superior skill often enables a man to handle an opponent much bigger and heavier than himself. Schools and colleges have wrestling trainers or coaches. The wrestler should know something of anatomy and

SOME OF THE TRICKY "HOLDS" AND "LOCKS" OF AN ANCIENT SPORT

The man at the left, above, has secured the famous hold known as the "full nelson," his opponent not yet having countered or blocked.



A Swiss champion, above, using a "half-nelson" and plenty of muscle.



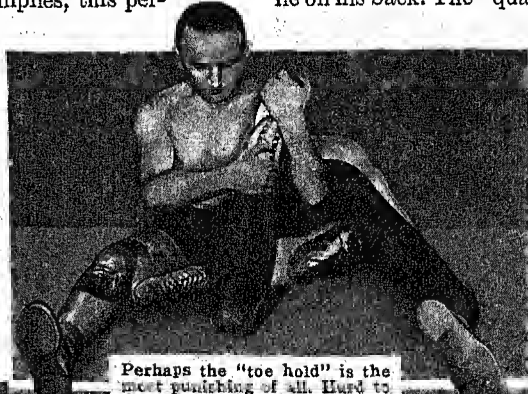
Here, at the right, a champion demonstrates the "headlock."

of leverage; the best men at the art often use a foe's own exertions against him, forcing a fall with but little exertion on their own part.

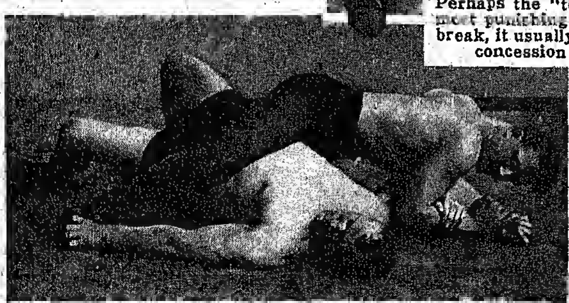
"Catch-As-Catch-Can" Wrestling

There are almost as many different styles of wrestling as there are peoples. In America and most English-speaking countries, the favorite style is "catch-as-catch-can." As the name implies, this permits almost unlimited action, such as tripping, struggling on the ground, catching hold of legs, in fact, practically anything except gouging, biting, and strangling holds or tactics which might injure an opponent permanently. A "fall" consists of pinning both shoulders to the floor at the same time. Sometimes one fall constitutes a match, sometimes victory goes to whichever of the wrestlers is first to win two falls.

One of the most effective holds is the "half-nelson," in which one arm is put under an opponent's arm, and the hand extended to the back of the head. This hold gives great leverage; it is continued by forcing the opponent's head down and towards oneself, at the same time raising his shoulder so he will roll over and lie on his back. The "quarter-nelson" is similar, except that the arm is placed directly on the back of a rival's head, instead of under his arm, and the other arm is thrust under his near arm and the hand locked on the wrist of the arm grasping his head. The "three-quarter" and "full nelson" are other variations of the half-nelson. The latter is a double half-nelson, with one hand grasping the wrist of



Perhaps the "toe hold" is the most punishing of all. Hard to break, it usually means a quick concession of the fall.



Another punishing hold that generally secures a fall is the "body scissors" demonstrated at the left. This will weaken a strong opponent, who may avert the fall for a time by "bridging," as the under man is doing here, until fatigue ends resistance. The picture at the right shows the application of a "three-quarter nelson," in which the bridge may come into use again, but can be easily broken without losing the advantage of the hold.

the other arm as the arms go under an opponent's arms and are locked behind.

The "toe hold" consists merely of grasping a foe's toes, or just a great-toe, in one or both hands and twisting his leg till he rolls over or concedes a fall.

"Hammer-locks" and "Scissors" Holds

There are many sorts of "hammer-lock," an exceptionally punishing hold. The simplest consists of grasping a foe's wrist and bending his arm behind his back, well up between his shoulder blades, while the attacker's other hand secures a waist or a leg hold. In a "chancery" hold, an opponent's head is locked under one's arm. A "lock" of any sort is secured by locking one's arms, or legs, about a foe. The "scissors" hold consists of locking one's legs about an opponent's body. The spectacular "flying mare" is secured by grasping a foe's wrist with both hands, turning one's back to him, and pulling him over one's shoulder. A "bar" is usually a straight arm across a foe's throat. A "strangle" hold is any which shuts off a rival's wind; such holds are usually barred. "Bridging" in wrestling means to hold the shoulders up from the floor by supporting the body on the head and feet when a fall is imminent. The "bridge" can be strengthened by holding the hands on the hips and resting the elbows on the floor.

The misnamed Graeco-Roman style of wrestling has little if anything in common with the sport of ancient Greece or Rome; it was developed in France. The rules are similar to those of catch-as-catch-can, except that holds below the waist are barred, and tripping an opponent constitutes a foul.

National Variations in Wrestling

In "collar-and-elbow" wrestling, the national style in Ireland, the rivals wear short jackets with strong collars and grasp each other's collar with the right hand, behind the left ear. The position of the hands cannot be changed until a fall is secured; changing the position of the hand or moving it is held to be a foul and loses a fall. Two shoulders and one hip, or both hips and one shoulder, must touch the floor at the same time for a fall.

In Cumberland and Westmoreland wrestling, popular in England, the contestants stand chest to chest and grasp each other about the body. The hold must be maintained throughout, for losing a hold gives an opponent a fall if he retains his hold. The man touching the floor with any part of his body except the feet loses a fall.

A Swiss variation of wrestling that is popular also in Russia is called *schwingen*, or swinging; the contestants take holds of strong belts attached to the wrestling breeches, or *schwinghosen*. Lifting and tripping tactics are employed, and the first man down loses a fall.

Two Styles of Japanese Wrestling

Wrestling in Japan dates before the Christian era. Two styles are popular, *sumo* and *jiu-jitsu*. The former is the national style. Weight is the chief factor, and so most Japanese wrestlers are enormously bulky. The methods are similar to those of catch-as-catch-can, but touching the floor with any part of the person except the feet, or stepping or being forced outside the wrestling circle, loses a fall. A similar sport is popular in India, but both shoulders must be pinned to the floor at the same time.

Tricks of Jiu-jitsu

Jiu-jitsu (also ju-jutsu and judo), upon which Japan's national system of physical culture is based, was introduced from China many centuries ago. For ages it was a secret art, guarded jealously by the nobility, or samurai; now it is taught everywhere, and a knowledge of its tactics is compulsory for soldiers, sailors, and the police. A thorough study of anatomy is essential, since jiu-jitsu depends not so much upon sheer strength as upon striking or twisting a foe so as to numb or disable him. It has been aptly called the art of conquering by yielding, for often the expert turns an opponent's own efforts against him, forcing him to strain or perhaps fracture his own arm or leg or even his neck. The expert makes a special study of such sensitive spots as the "funny-bone" (the partly exposed nerve of the elbow), the solar plexus, or nerve-center at the stomach, the nerves of the upper arm, the Adam's apple, the ankle and wrist bones, and various other parts of the body. Carried to extremes, the tricks of jiu-jitsu can easily be fatal. In Japan women as well as men often are taught its methods of trickery. In athletic competition, the one in danger of injury from an opponent's grip admits defeat by tapping the floor with hand or foot. It differs from other styles of wrestling in this, since no particular fall is needed. In fact, the art of falling without injuring one's self is a first principle of the art, because often an expert will fall himself in order to trap an unwary opponent into a dangerous position.

WRIGHT, ORVILLE and WILBUR. Probably no men in history ever enjoyed a greater thrill than these two brothers experienced when on Dec. 17, 1903, they made the first successful airplane flights in history. Orville Wright made the first flight, covering about 120 feet in 12 seconds. Later that day Wilbur flew 852 feet in 59 seconds, then crashed and wrecked the machine; but the brothers returned to the bicycle shop they owned at Dayton, Ohio, quite happy. They had conquered the air at last!

Orville Wright, first man to fly in an airplane.

A biplane glider, with a gasoline engine fastened to it, was the first airplane. For years these two sons of a clergyman, who was later Bishop Milton Wright of the United Brethren church, had followed the experiments of Lilienthal, Langley, Chanute, and other pioneers of flight. They studied the soaring of birds, and the action of larger and larger box-kites. Then they decided that in order to learn to fly, one must actually *fly*. So they built gliders, much like long box-kites with two wings and a rudder to guide the machine.

In 1900 and for two years after, they practised gliding at Kitty Hawk, N. C., where the Weather Bureau had told them they should find favorable winds, and hills to give them a jumping-off place.

Repeated glider flights showed that accepted air tables were wrong, and in the winter of 1901–02, they built a wind tunnel to measure air currents for themselves. In this tunnel, 16 inches square and 6 feet long, they measured the air's force against 200 miniature wings of varying proportions and set at many angles. Thus they made the first accurate air tables ever compiled. They also discovered how to maintain lateral equilibrium by warping or twisting the wings. Then they resolved to see if such a machine could be propelled by a motor, and built one themselves, a four-cylinder affair of 12 horsepower, weighing about 200 pounds.

Wilbur Wright, co-inventor of the airplane.

In September 1903 the brothers went to Kitty Hawk to assemble a new glider, larger than any previous one. The wings were 40 feet 4½ inches between tips, and 6½ feet wide. They built a 60-foot monorail track from which to start with the least possible friction. When all was ready they tossed a coin to see who should fly first. Wilbur won, but fell, and two days were spent repairing the damage. Then Orville made his historic flight. From 1903 to 1908 the Wrights improved their airship, working mostly in secret. Failing to find a practical interest in their invention among government officials in the United States, they went abroad. In 1908, Wilbur toured Europe, demonstrating their machine, and sold the French rights to their patents for about $100,000. The American government meantime had offered $25,000 for any heavier-than-air machine, operated by fuel, that would carry a passenger and fuel for at least 125 miles and fly at 40 miles an hour. Orville exceeded those demands at Fort Myer, Va., in September 1908, and thus the brothers became the pioneers of military as well as civil aviation.

Wilbur Wright was born at Millville, Ind., near New Castle, Apr. 16, 1867. His parents moved to Dayton, Ohio, where Orville was born Aug. 19, 1871. Wilbur died May 30, 1912. The brothers set up a bicycle factory in Dayton, where they built their first airplanes. (*See also* Airplane.)

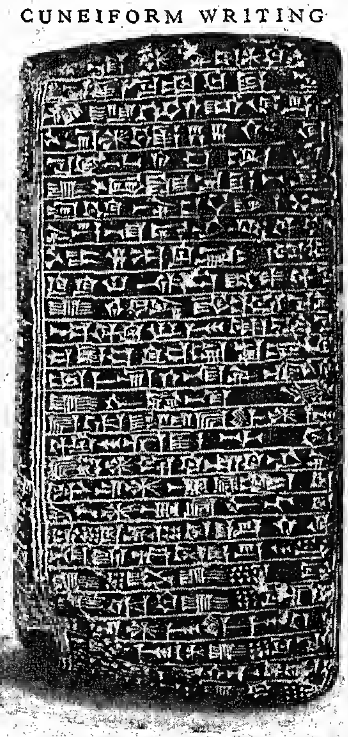
The GREAT INVENTION *Which Preserves* THOUGHTS

WRITING. From almost the earliest days, men made pictures to serve as records of hunts, wars, and events in tribal life. They also learned to send written messages in pictures. For example, a picture of the sun was used to mean a day. Two marks beside the sun meant two days. We call such signs *pictographs.* The Indians of North America used this pictographic method of writing (*see* Indians, American).

All primitive peoples, as far back as we know, have been able to write in this way. The first advance came when civilization developed in certain lands. Then men speeded up the older method by simplifying the pictures. The Egyptians, for example, used a wavy line to mean a body of water. The Chinese used an ear between two doors to mean "listen." Such signs are called *ideographs* or *ideograms.*

Early writing was influenced by many factors, particularly by the materials available. The Egyptians developed beautiful signs called *hieroglyphics* for writing inscriptions on tombs and monuments and for writing religious texts and important documents. (The name hieroglyphic is from the Greek *hieros,* "sacred," and *glyphein,* "to carve.") For less important writing the Egyptians used simpler *hieratic* signs, made rapidly with a brush and ink on papyrus. After the Chinese invented paper, they too wrote their signs with a brush and ink. (*See* Egypt; Paper; Papyrus Plant.)

CUNEIFORM WRITING



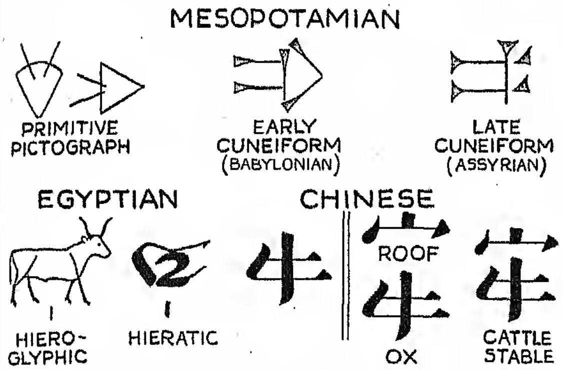
This inscription on black stone tells how Esarhaddon of Assyria restored Babylon in the seventh century B.C.

Because the peoples of southern Mesopotamia lacked both stone and material suitable for making paper, they stamped their signs on wet clay with the cut end of a reed. This method produced wedge-shaped marks; hence we call such writing *cuneiform,* from the Latin *cuneus,* "wedge." To preserve the message, they baked the clay. (*See* Babylonia and Assyria.)

As civilization further developed, men needed more and more signs. Then they devised the simpler method of spelling words according to sound. For example, in English we could write the word *belief* by drawing a bee and a leaf. We call such signs *phonograms,* and a combination of such signs forms a *rebus.*

Each of these phonograms stands for a syllable or group of sounds. The bee stands for *b* and *ee* combined; the leaf stands for *l*, *ee*, and *f*.

DIFFERENT WAYS OF WRITING "OX"



The top row shows the development of the cuneiform sign for "ox." The sign started as a pictograph, a rough sketch of a head and horns. The Babylonian sign, an *ideograph,* imitated the second head by making wedge-shaped characters in clay. Later the Assyrians simplified the sign so that it no longer resembled an animal. The Egyptian hieroglyphic below was an actual picture. It was imitated roughly in the hieratic sign following, which was written with a brush. The Chinese sign is much like the Assyrian, but it is written with a brush and ink and it has a bulge to the left for a head, an upright forehead, and two projections for horns. The group of signs in the corner at the right shows how the Chinese combine "ox" and "roof" to mean "cattle barn."

Every language has hundreds of different syllables, and so this method required hundreds of signs; but still *syllabic* writing was a great improvement over the ideographic, with its thousands of signs. Most early ancient nations adopted the new method, but retained some of the older ideographs. Even today we use ideographs when we write $ and ¢ instead of spelling out *dollars* and *cents.*

The Chinese never made this change, and their written language consists of thousands of ideographs (*see* China). The Japanese moved on to the syllabic stage. Most of the American Indians did not advance beyond picture writing, but the Mayas made some use of ideographs. The Aztecs and others who followed the Mayas imitated Mayan writing. Scholars are uncertain how far they advanced, because only a few specimens of their writing survived the Spanish conquest, and even these have not been deciphered completely. (*See* American Archeology; Aztecs; Yucatan.)

The Alphabet and Modern Writing

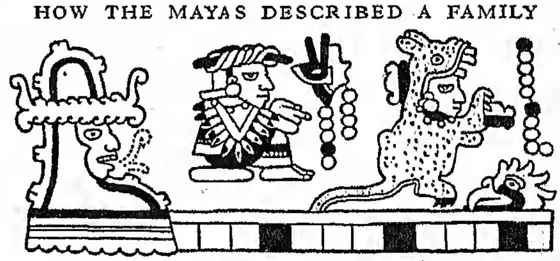
For a thousand years or more men wrote with ideographs and syllabic characters before they hit on the idea of using an alphabet of single letters. This improvement was not hard to make, because all the syllables in any language are made up of a few single sounds. If signs are adopted for these single sounds, any syllable can be written by combining the right sound signs. For example, to write the English word "belief" we could use the bee phonogram (mentioned above) for the *b* sound, and use the leaf sign for *l.* Then we should need signs for *ee* and *f.* A picture of an eel could do for one, and a fox for the other.

Both the ancient Egyptians and the Babylonians knew how to write in this simple alphabetic way, and they used it occasionally, particularly for writing names. But for the most part they were satisfied with their older ideographic and syllabic writing, and alphabetic writing did not get a real start until some Semitic neighbors of the Egyptians needed to learn how to write, about 2000 B.C. The Egyptians taught them the simple way of writing with "single sound" letters. From this beginning came the Greek and the Latin alphabets which are used today by most peoples outside Asia (*see* Alphabet).

Printed and written letters change constantly; we find many changes in English, even within the past two or three centuries. Washington's handwriting differs markedly from the styles in use today.

As trade and travel bring the nations into closer relations, they tend to adopt the Latin alphabet. The Japanese have begun to use it for commercial purposes, and Turkey in 1928 abandoned the Arabic alphabet for a modified version of the Latin.

HOW THE MAYAS DESCRIBED A FAMILY



The pictographs above mean "Nine Wind and his wife, Tsn Eagle, who live at Cloud-Belching Mountain." The mountain, or volcano, is at the left. Then we see Nine Wind, named by a wind symbol and nine circles. His wife is named by an eagle and ten circles. The signs are from one of the few existing manuscripts which show this writing. The people who wrote it lived after the Mayan power had vanished, but they used the Mayan script.

The Fine Art of Writing Good English

WHEN we study English composition, we may have one of two purposes in mind: we may wish simply to write clearly, correctly, and effectively; or we may wish to develop a natural talent and produce the vivid, skilful writing which is an art.

We all need to write correctly, even though we may not hope to become authors, just as we all need to brush our hair, wash our faces, and keep our clothing neat and clean. Slovenly, sloppy, helpless writing is just as much of a social handicap as an unkempt, dowdy appearance. (*See* Grammar; Rhetoric.)

Fortunately, anyone of normal intelligence may, with reasonable study, learn to write correctly. He may be taught, by the aid of a good textbook on rhetoric and a competent teacher, to put his thoughts in writing that is clear, unified, logical, and well proportioned. Devices of sentence structure that will insure variety or clarity are simple to learn. No one need write verbosely, tritely, or ungrammatically.

You Must Have Liveliness

Unfortunately, if we aspire to literary excellence, mere correctness is not enough. To be sure, good

literary writing is damaged by incorrectness and improved by correctness, just as is good commonplace writing. But a tidy little theme, in pretty handwriting on clean paper, with spelling and grammar and punctuation exactly right, may be as dull and boring as a headache. Again, some lively fellow's careless product, with commas missing, grammar trodden under the racing heel of bright vernacular, spelling nearly as strange as Shakespeare's, may breathe that breath of life by which we recognize the presence of the literary gift.

The faulty, lively writing is not good because of its flaws, but in spite of them. It is easier to weed faults out of a student than to infuse vitality into him. Few succeed in any art who do not glow with mental vitality, whose original sensory impressions are weak, whose visual, auditory, and other sensory memories are dim.

Your First Step in Learning to Write

Therefore, if you wish to write professionally, your first study must be the study of yourself. Have you this essential vitality of the spirit? Do your senses emboss impressions upon your memory with distinctness? By vitality we do not mean noisy robustness, aimless coltish activity, violence, exaggeration. Voltaire was a semi-invalid, but he sailed into the stupidities and cruelties of his day like a wild man, ran away, charged back again, with mental energy enough to remake the world's thinking and touch off a revolution. He was splendidly alive to the life about him. Vitality means awareness, responsiveness, keenness.

You may have vitality and intelligence, and still your mind may be one of those which are weak in images. These are by no means necessarily weak minds. They may be capable of rapid and brilliant association of ideas, skilful in logic and reasoning. But they are totally hopeless in the arts.

Developing Power of Imagery

To test yourself for power of imagery, recall to mind some interesting scene—a waterfall, or rapids, for instance. Can you see plainly in your mind's eye the white shine of the water, the green branches of trees beside the stream? Most people can, for most people have visual memory. Can you also recall clearly in your mind the roar of the water, the gurgle between rocks, the whisper of the spray? Then you have auditory memory, which is completely lacking in some people. Can you recall vividly the smell of the mist and rotting leaves, the chill of the water on your hand, the taste of a pine needle or bit of sorrel you may have picked up and chewed, the slip of your foot on a slimy rock and your lurch and sway to recover balance? To do this, you must have memory of the impressions of smell, taste, touch, and muscular movement; such memories are considerably rarer than either the visual or auditory kinds. If such sensory impressions come back to you in imagination almost as clearly as though you were going through the actual experience, you have a foundation for success in writing or in some other art.

Note how Rudyard Kipling, famous for the vividness of his character and nature descriptions, calls in all of the "five senses" but one—the sense of taste—in telling of a landscape in 'Namgay Doola': "The night had closed in rain, and the rolling clouds blotted out the lights of the villages in the valley. . . . The monkeys sung sorrowfully to each other as they hunted for dry roots in the fern-draped trees, and the last puff of the day-wind brought from the unseen villages the scent of damp wood smoke, hot cakes, dripping undergrowth, and rotting pine-cones. . . . The clouds closed and the smell went away, and there remained nothing in all the world except chilling white mists and the boom of the Sutlej River."

If you can not recall sensory impressions to your own mind, you may be absolutely sure that you can never recall them to the mind of a reader. If you can write about lassoing a horse without feeling a pull in the muscles of your arms, you may be sure your reader will feel no such pull. To enable someone else to share his own thoughts and emotions is the task of the artist.

It is of course true that if your memory in some of these aspects is weak, you may strengthen it amazingly by training, by conscious effort to observe more keenly and remember more vividly. Even a person whose mind is by nature a genuine motion-picture theater of vivid images, with sound and smell and touch effects included, may still increase his powers by practise and continued study. But no one can mine gold where there is no ore.

You Must Read and Study

If you believe you have the "ore," begin to mine it by studying good writing, great writing. Absorb its principles into your blood and nerves and ears and eyes—a matter which is a far cry from being able to give an intelligent critical report of what you read. Great writers are usually great readers, but not everyone who has his nose constantly in a book is a great reader. He may be merely a great dunce, a person incapable of extracting the sap of life from the world about him, and wholly dependent on coddling and feeding his mind with the prepared food of books. The intelligent reader reads, not to copy some other man's style, not to prop himself up with some other man's strength, but to see how words and ideas take on new power as they pass through the filter of new minds; how new rhythms and new phrases and new figures appear in the light of another personality. Such observations open out to the reader the infinite possibilities of language, of life, of individual thought; they do not shut him up in the cage of what has been done in the past.

What Makes Good Writing?

After reading attentively and reflectively for a while, you begin to notice certain important facts about good writing. Among them are these:

1. That words have within themselves color, richness, personal life. Some words open like a gate and reveal a long vista. Others are dull, lumpish, unservice-

able. On the outer edge of the exact meaning of a word lies a fringe of suggestion, known as "connotation." "Fist" means simply "a closed hand," but it makes you think of fighting.

2. That sentences and whole passages have rhythm, subtly in tune with the mood, emotion, action, or tone of the subject matter.

3. That one specific instance is worth a score of generalizations; that selectiveness and concreteness are our tools for making clear the complex and the abstract.

4. That simplicity makes for clearness, strength, and beauty.

5. That good writers use very cautiously the passive voice and the verbs "to be," "to appear," "to seem," and "to become," and amateurs are fatally lured by them.

Let us examine these matters one by one, beginning with the flavor of individual words. In no way can they be better studied than by following that ancient piece of literary advice to read the King James version of the Bible. Consider the famous sentence, "Though I speak with the tongues of men and of angels, and have not charity, I am become as sounding brass, or a tinkling cymbal." Why is that a tremendously good sentence? The writer is trying to ring out the idea that a man endowed with rich and kindly feeling will make his natural gifts effective in his life, whereas a man dried up at the source of his emotions will be an echo, a trivial creature. Say it to yourself aloud. "With the tongues of men and of angels." "With the tonnnnnnngues of mennnnn and of annnnnngels." Is not that repetition of the "n" sound significant? Does it not have the depth and richness of a sweet-toned bell? And what could be a more kittle-cattle racket than "tinkling cymbal," with its *"ink ing ym"*? By connotation of the words, by the subtle suggestion of their sounds, as much as by their dictionary definition, the translator conveys the inner thought of the lines which have rung in men's minds for centuries.

Gaining a Feeling for Words

How can one acquire this feeling for words, this gift of tongues? Simply, as has been said, by cultivating and deepening the sensory memories. If you have never listened to the sound of cymbals, *pingity pingity ping*, until the ringing bit into your attention in an almost hypnotic way, until you felt the last nerve-scratch, the very essence of the sound, as a purely sensory experience, and then in brooding moments let it tie itself in your mind with similar essentials of sound and feeling and meaning, you can never truly understand St. Paul's simile, much less make good ones of your own. This ability no teacher can pour into your ear, you must achieve it in the slow, tedious silence of self-discipline.

In much the same way you may gain skill in using rhythm, the second of the matters we are considering. Rhythm is of course easiest to study in poetry.

> Thy long blue solemn hours, serenely flowing.

Thus Browning wrote of an idle day in the Italian hills, fluting along smoothly as lazy hours pass. Of a horseback ride, Browning's rhythm was:

> As I ride, as I ride,
> With a full heart for my guide.

This is exactly the rhythm of a horse when he single-foots.

Rhythm is quite as important, though not so regular, in prose as in poetry. Nowhere can we find better examples of compelling rhythm in prose than in the Psalms. Here is the leaping rhythm of troubled water: "Deep calleth unto deep at the noise of the waterspouts: all thy waves and thy billows are gone over me." How subtly different is the relentless lapping of flood waters: "The floods have lifted up, O Lord, the floods have lifted up their voice; the floods lift up their waves."

Rapid, almost humorous, is the tune of the animated landscape: "The mountains skipped like rams, and the little hills like lambs."

The flutter, frantic dash, and flight of a bird is in: "Our soul is escaped as a bird out of the snare of the fowlers: the snare is broken and we are escaped." Who has not been amazed by the trumpeting march of these simple words? "Lift up your heads, O ye gates; and be ye lift up, ye everlasting doors; and the King of glory shall come in. Who is this King of glory? The Lord strong and mighty, the Lord mighty in battle."

These examples alone should be sufficient to refute that silly piece of advice often given to young writers: "Always make your writing run smoothly." Your writing should run smoothly only when you are writing of smooth running things. When your subject is animated, let your writing "skip like rams."

Avoid the "Dying Fall"

There is one sort of rhythm which will sometimes creep into writing when the writer is quite unaware. It is the rhythm of the "dying fall," in which the sentences fall limp, and droop, and drop, and end with a sickly plop, with the sad sound of a milk bottle rolling down the back stairs. Such a rhythm seriously weakens your writing, unless, like Tennyson in 'The Lotus-Eaters', you wish to convey the mood of drowsy, feeble people. Here are some of Tennyson's lines:

> In the afternoon they came into a land
> In which it seemed always afternoon.
> All round the coast the languid air did swoon,
> Breathing like one that hath a weary dream.
> Full-faced above the valley stood the moon;
> And, like a downward smoke, the slender stream
> Along the cliff to fall and pause and fall did seem.

You may hear this dying fall in your writing if you compose something when you are ill, or tired, or lazy. The only remedy is to "snap out of it." Come to life, and life will come to you.

Use of the Specific Instance

Now we reach the very important matter of the specific instance. Montesquieu, wishing to point out that a despotic government sacrifices the hopes and resources of the future for trifling present gain, says: "When the savages wish to have fruit they cut down

the tree and gather it. That is exactly a despotic government."

G. K. Chesterton, who continually delights us by his surprising use of specific instances, says, in an essay on 'A Defense of Nonsense': "So long as we regard a tree as an obvious thing, naturally and reasonably created for a giraffe to eat, we cannot properly wonder at it. It is when we consider it as a prodigious wave of the living soil sprawling up to the skies for no reason in particular that we take off our hats, to the astonishment of the park-keeper."

He might have been dull, abstract, and unclear by saying: "The feeling of wonder may be aroused by applying the imagination to the contemplation of any common object."

Being specific sometimes takes the form of using similes or metaphors. Oliver Wendell Holmes, in 'The Autocrat of the Breakfast Table', writes: "People that make puns are like wanton boys that put coppers on the railroad tracks. They amuse themselves and other children but their little tricks may upset a freight train of conversation for the sake of a battered witticism."

The abstract, unspecific way of saying it is: "A pun is boring because, while funny in only a silly way, it annoyingly interrupts the flow of conversation."

'The Autocrat of the Breakfast Table' abounds in the admirable use of the specific instance. A generalization is stated, then pointed up immediately by the specific, as in the following bit: "You see, my friends, what immense conclusions, touching our lives, our fortunes, and our sacred honor, may be reached by means of very insignificant premises. This is eminently true of manners and forms of speech; a movement or a phrase often tells you all you want to know about a person. . . . One of my friends had a little marble statuette of Cupid in the parlor of his country-house —bow, arrows, wings, and all complete. A visitor, indigenous to the region, asked the lady of the house 'if that was a statoo of her deceased infant?' What a delicious, though somewhat voluminous biography, social, educational, and esthetic in that brief question!"

The Importance of Being Simple

Just as we must make our ideas clear and incisive by letting the concrete example stand for the abstract thought, and the few selected details tell the tale for the many, so we must reduce our most elaborate, learned, or technical notions to simple language. The beginner scarcely realizes how much harder it is to be simple than to be complicated. The young writer yearns for long words, fancy phrases, obscure verbiage. The mind trained in science, but untrained in expression, feels deeply grieved to read a scientific thought expressed in human speech instead of in the jargon of the laboratory.

It is the pride of the makers of Compton's Pictured Encyclopedia to have taken issue with conventional encyclopedia diction and to have put difficult subject matter into words "understanded of the people." Let us take as our example of simplicity in writing the first paragraph of the article in this encyclopedia on Plant Life: "The first thing to keep in mind about plants is that they are *alive*. They eat and drink, they breathe and move, they rest and sleep, they are born and die, very much like men and animals. Most of them 'see' after their own fashion, and many have exceedingly sensitive reactions to touch and other stimuli. They grow strong and healthy with plenty of good food, but get sick and pine away if the food is bad or scarce."

That paragraph is so simple that we feel it must have been easy to write. Yet how would those very same ideas be expressed in the typical botany or reference work? Probably in some such fashion as this:

"It must be borne in mind at the outset that all members of the vegetable kingdom are living organisms, which absorb nutriment and moisture, which exhibit the phenomena of respiration and (to a limited degree) of locomotion, which pass through periods of quiescence and hibernation, which reproduce and undergo ultimate disintegration, in accordance with laws similar to those which govern the animal kingdom. The majority of plant species has photosensitive organs and many respond readily to tactile and other stimuli. When provided with the nourishment specifically suited to them, they show normal growth and development; however, if the nourishment is not in accordance with their requirements, they develop symptoms of retardation and emaciation."

What is the matter with the second phrasing of the paragraph? Everything. It is heavy-handed and leaden-footed, dull, pretentious, and obscure. It throws a useless smoke-screen of scientific jargon about simple ideas. Worst of all, it is not interesting, and it makes a genuinely interesting subject appear to be stupid.

Let us note particularly one detail about this absurd rewriting of the paragraph: the words, organisms, nutriment, exhibit, respiration, locomotion, quiescence, hibernation, reproduce, ultimate, disintegration, accordance, majority, and a number of others, are all of Latin derivation. Many times you will hear the advice given, "avoid Latin-derived words, stick to the plain Anglo-Saxon."

Words from the Latin Have Their Use

This advice is, in fact, not at all sound. But such writing as Exhibit No. 2 above would almost convince you that Latin-derived words are a menace. The fact is that Latin words came into the English language centuries ago in the mouths of the Latin-speaking priests and scholars, and the French-speaking Normans who conquered England. Hence those words, or many of them, have come to be associated with solemn, elegant, abstract, learned, or even highfalutin usage. That is not true of all of them. The word "table," from Latin, is no more high-flown than "door." But when we hear the French speak of putting "undulations" in their hair it makes us grin, because an "undulation" in English is so much more overpowering in its connotation than is "wave." Latin

words have a roll, a grand sweep, which we should sadly miss from the truly remarkable English language. Shakespeare made excellent use of them in the speech of Lady Macbeth, that water would not wash the spot of blood off her hand, but that the blood would rather "all the multitudinous seas incarnadine." The moaning roll of those words is much easier to achieve with Latin-derived words than with "plain Anglo-Saxon." We need not, therefore, fear to employ Latin words, but merely refrain from "making our little fishes talk like whales."

Proper Use of Verbs

The same sort of advice applies to the over-use, or misuse, of the verbs "to be," "to appear," and "to seem." One of the conspicuous and universal errors in amateur writing is the heavy output of such sentences as these: "The lake was bright. The waves appeared to be trying to outdistance each other. The scene seemed to be a dream." No genius is required to write, "the lake sparkled, as the waves raced to the shore," and a grain of common sense will lead us to omit the silly bit about the scene.

Mistaken use of the passive voice likewise undermines a sentence. "John was given to understand by Peter that the book was to be found on the shelf," is a poor way of saying "Peter told John the book was on the shelf." The passive voice is bad, when wrongly used, because it is weak. Weakness is bad, always, in your thinking, in your writing, in any art.

Choose Subjects from Your Own Experience

Many more such packages of good advice might be offered the young writer, and still he would feel, "This may all be very true about *how* to write. But *what* shall I write, how shall I go about gathering material, how shall I approach the task of getting it on paper?" The answer is that literature, like charity, begins at home. Write about something close to you, something you know from experience. You may also, of course, find material to write about in books. But there is much more useful training to be had from writing about what is right under your nose. You may have read a fascinating history story about how King Louis built a great fort when he went away on the Crusades. Nevertheless, you were not there, you cannot, without tremendous research, know what the workmen may have said, how they worked, what they thought. But over in the next street, this very day, workmen are putting up a new garage, a commonplace ugly thing, not a bit like a medieval castle. Go over to this garage, listen to the workmen, catch the rhythm of their words and phrases, note the stiffness of that man's new overalls, and the puffiness of this chap with two sweaters under his jacket; watch the movement of their bodies as they hoist two-by-fours, or smear mortar; note the color and texture of fresh bricks or new wood against the blue, or gold, or red, or slaty sky. Then try to put all that on paper so that someone else can really see and hear and smell it too. Never mind whether what you write is a simple description of the scene, or a little story that comes to you as you watch the garage go up, or an account of just how the work is carried forward.

Various Forms of Writing

Writing, as practised by the human race for centuries, has of course developed certain forms, just as clothing has developed styles. We say that a certain piece of writing is a bit of description, an essay, a biography, a poem, a debate, or some form of narration, such as a short story, a novel, a play, or a sketch. It is inadvisable to set your teeth and say "I am now going to write an essay" in a sort of "Pikes-Peak-or-bust" spirit. First, catch your hare, that is, get in mind some material about which you would like to write. Then judge, from the way the material shapes up in your mind, what form would be most effective in developing it. It may lend itself to various forms, and you may gain flexibility and skill as a writer by developing it in several ways.

For example, you may be entertained one day by the sight of a little band of street musicians, or an organ grinder with a monkey. On this theme you may write a simple description, tell how these people looked and acted. You may wish to imagine a day in their life, and give a straight narrative account of it. Such a chronological account is more likely to be a sketch than a short story, novel, or play.

Sketches Are Not Stories

It is not possible here to go into the precise definitions and requirements of short stories, novels, and plays. But in general it may be said that writing a sketch differs from writing a short story in the same way that weaving cloth differs from cutting and making a garment. The sketch never makes a plot, nothing evolves or grows in it. It is really a sort of description which makes use of narrative. Perhaps a genuine story will weave itself in your mind around the figures of the street musicians. Try it out as a short story, or a little play.

Write a poem on the theme, if you catch a poetic glimpse of the street musicians in your mind. Some first-rate poetry has been written by children as young as eight years old. The best of adult poets have usually done their best work while still young. Above all, do not imitate some poem you have heard, but let your poem find its own rhythms. (*See* Poetry.)

Sketches are pleasant to write, and excellent practise before attempting the more difficult forms of narrative. Subjects for them are easy to call to mind. Perhaps your house once caught fire, or you spent a night lost in the woods, or you tried to bake a cake or mend a chair all alone, or you can recall the interesting sights and sounds of a morning on a farm. Any of these may make good sketches. Historical sketches may be written on such topics as the history of your own town, an account of Benjamin Franklin at the French court, or a family Christmas party in 1776. Foreign or ancient Christmas customs are a theme for either a sketch or a simple description, and likewise are accounts of a half-hour in a department store, or ten minutes on a busy street corner. Lively descrip-

tions may be written of a peanut and popcorn stand in a park, a deserted house, an interesting or unusual person you often see, the ways of your pets, or a picture you admire.

If your grandmother has told you a tale of her youth, or you have heard an old legend or half-true story, or have had some exciting experienee, you may work out from these themes a more formal and complicated plot, a genuine short story.

The Essay—"A Little Sally of the Mind"

On the other hand, a dreamy topic such as "People I Should Like to Have Known" is almost certain to result in an essay, a form of writing which may employ bits of narration or description or exposition, but which is best deseribed as "a little sally of the mind" into some subject. The essay does not seek to narrate, to make clear, to prove, or to solve anything. It merely allows the fancy to play over a subject. Since the writing of a successful essay usually requires fine and sure taste, wide experience, wide reading, subtle humor, and a strongly developed personality, it is not likely to be best accomplished by a young person. However, if an essay theme suggests itself, do not hesitate to attempt it because you feel you are too young. Your topic may be well within your powers, you may have precisely the essay type of mind, though your years and your knowledge may be brief. (*See* Essay.)

Like the essay, any piece of exposition requires that its form be developed directly out of the material. It must, like the coral polyp, build its own skeleton as it goes. No story runs through to carry it along. The logical outline and general scheme must be very elear in your mind before you start to write. The function of exposition is to explain, to make clear. You may choose a simple subject such as how to make a kite, a scooter, or a playhouse, or explain what you have found to be the best method of studying something, or give an aecount of glass-blowing or any other interesting process of manufacture or work of skill which you have seen. Topics requiring research, such as "The Changes in the Government of Turkey Since the World War," or "Why the Chinese Starve Amidst Rich Resources," are valuable if you thus acquire the habit of knowing the world in whieh you live, keeping up with world events instead of your own little cabbage patch. They are detrimental if you merely acquire the habit of talking knowingly of things about which you know little or nothing, of expressing opinions which you have had no opportunity of forming correctly, in short, of talking through your hat.

A young writer is far more likely to write a thoroughly interesting and lively exposition on "How to Get a Job," based on material obtained from actually going out and applying for a job.

Biography a Good Exercise for Beginners

A research subject better suited to young writers than the heavy political subjects so often assigned them is the writing of a biography, particularly the biography of a vivid personality, such as Daniel Boone, Dolly Madison, or Pierre Radisson. You might even try a semi-fictional biography of that little known signer of the Declaration of Independenee, Button Gwinnett. The movement of their lives will lead you to some sparkle of expression, some imaginative share in the life of their day.

No matter what form of writing you undertake, you must learn by trying various methods what is your own best procedure in writing. Most people find it simplest to jot down in note form their first ideas, sort these out into a systematic arrangement, write an outline in eomplete sentences, and then develop, fill out, and improve the outline. Others, with a very retentive memory, prefer to plan the whole composition mentally, and put on paper a perfeeted piece of writing. Methods of writing are only to be judged by results. The scheme which gets you the best results, which is best adapted to your own habits of mind, is the best scheme for you.

How to Prepare a Debate

The debate, the last of the forms of writing under consideration, has a set form. It is an exercise in logic, but it need not be, though it often is, a stodgy lump of ill-digested ideas expressed in high-sounding words. As in the case of subjects for exposition, the choice should be made among subjects lying at least partially within the experience of the writer. Young writers will know far less about "Resolved: That the Russian Five-Year Plan is a Failure" than about "Resolved: That Our City Should Own a Garbage Reduction Plant."

A subject for debate must be stated in the form just given, and must involve a question that may be argued. "Free Trade" is not a debatable subject. "Resolved: That Free Trade is Better than Tariff Protection" is debatable. "Resolved: That Milk is a Good Food for Babies" is not debatable.

The argument is always stated in its positive form, and one team takes the affirmative side of the question, the other the negative. Each team should study the other side, however, to be prepared to speak in rebuttal. The brief should be drawn up like the following model:

RESOLVED: THAT WOMEN SHOULD RECEIVE THE SAME PAY AS MEN FOR EQUAL WORK

Introduction of Subject

I. We use the term *pay* as being inclusive of *wages* and *salary*.

II. By *work* we mean both manual and mental labor.

III. It is not to our purpose to trace the history of woman's activity in the economic order of the world.
   - A. For this has no direct bearing upon the subject.

IV. The subject to be discussed is of interest, because—
   - A. The number of women who are devoting themselves to business, industrial, and professional life is steadily increasing.
   - B. There is a growing movement in these fields to employ women in the same work that is done by men.
   - C. The instability of the modern economic order necessitates that every woman be fit and able to support those dependent upon her should the occasion arise.

V. If we can prove that women are entitled to equal wages with men, because (a) they similarly contribute to the support of dependents, (b) are as efficient as men in the same tasks performed, and (c) are unjustly hindered by the law of supply and demand to the detriment of society, we shall provo our proposition.

Proof of the Argument

Women should receive the same pay as men for equal work, because—

I. They similarly contribute to the support of dependents, since
   A. Three surveys made by the Woman's Bureau of the United States Department of Labor reveal that
      a. In a study made of 843 mothers in Chicago, Ill., 68 per cent of the families had no support from the father; in less than 20 per cent of the cases was the father a regular contributor.
      b. More than half of 60,000 women investigated gave all their earnings to the family.
      c. Among 17,000 unmarried women workers it was found that 1 in 5 cared for a family which was getting no help from male relatives, and 1 in 11 was the sole earner in the family.
   B. Women are as efficient in the same tasks performed:
      a. Intellectually, as
         1. Although there may be mental differences, as yet unproved, between men and women, when measurement tests of efficiency are applied to men and women equal results are obtained.
         2. The very volume of women in the occupational fields testifies to their capability, as
            —There are more than 2,600 women lawyers, more than 9,000 physicians, 9,000 writers, 13,000 librarians, 73,000 musicians and teachers of music, 270,000 social workers, 600,000 teachers.
            —In addition to those in the professions, there are other thousands in business, trado, and industry.
      b. Manually, as
         1. In a New York factory women displaced men on machines that produced steel piece-work and their daily piece total was higher than that which the men had attained.
   C. Society suffers from the bonds placed upon women by the so-called law of supply and demand, for
      a. Business scientists point out that, by underpaying women, executives are hampering the very cause for which they aro theoretically working—the cause of promoting the welfare of the individual and the community, the cause of perfecting civilization for the benefit of all, since
         1. to lower buying power is to lower the standard of living.

Conclusion of the Argument

If, then, as we have tried to prove, our statements in A, B, and C, are correct, women should receive the same pay as men for equal work.

In formal debates there are usually two or three members of each team, and the particular points to be covered by each member are determined at the outset. Each succeeding speaker also endeavors to point out the weak points in the arguments of the opposing side. In classroom debates, with two speakers on each side, the following order is generally observed: opening speeches, affirmative, negative, affirmative, negative; speeches from the floor, in alternate order; in rebuttal, negative, affirmative, negative, affirmative.

WYCLIF (*wĭk'lĭf*), JOHN (about 1320–1384). Almost six centuries ago an English priest stood on trial before the archbishop of Canterbury and the bishop of London. A tall figure, clad in a simple black gown, pale and thin, with keen, sharply cut features that bore the marks of earnest study and of self-denial, he faced his accusers with penetrating gaze, and spoke resolutely. This clergyman was John Wyclif, the Oxford scholar and teacher, called to account for criticizing the church.

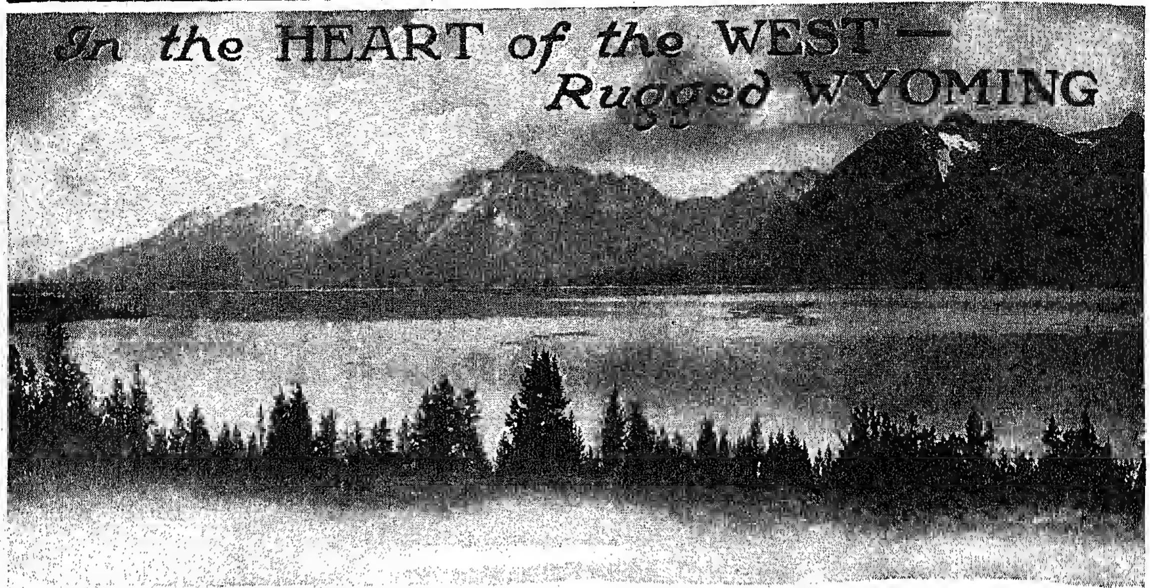
At that time a dispute was going on in England between the crown and the church. The pope claimed the right to collect taxes and to make appointments to church offices without interference from civil authorities. The latter opposed this claim, and Wyclif supported their views. The church, he said, should hold no property and should concern itself only with spiritual matters, leaving temporal matters to statesmen. He argued against the levying of taxes by the church and attacked the luxury in which many churchmen lived.

It might have gone hard with this defiant clergyman, whom his foes called "John Wicked-believe," if a crowd of his supporters had not caused such a disturbance that the court was broken up. Wyclif was set free, with a warning to be careful what he preached.

But Wyclif was supported by John of Gaunt (who was the power behind the throne) and by the great nobles, so long as he denounced rich churchmen. So he continued to preach as fearlessly as ever, though the pope himself issued bulls or papal decrees against him, and his teachings were condemned at the University of Oxford. He sent out "poor priests"—Lollards they, like all his followers, came to be called—who traveled throughout the country calling men back to faith in the simple gospel of Christ.

Wyclif lost the support of the great nobles after the Peasant's Revolt in 1381. His teachings that lordship and property were held only by God's grace and were forfeited if the holders fell into mortal sin had contributed not a little to this movement. In order that the people themselves might be able to read and understand the Bible, his followers made the first full translation of it into English (1382). To this important work Wyclif's name was attached although his direct part is a matter of uncertainty. Not only did this translation have a tremendous influence on people, but it set the standard of their language, and earned for Wyclif the title "father of English prose."

Wyclif has been called the "Morning Star of the Reformation." Although he died without having brought about any great change in the church, his teaching had a powerful influence on John Huss, the Bohemian reformer, and through him on Martin Luther. (*See* Reformation, Protestant.)



Jackson Lake in Western Wyoming, 6,800 Feet above the Sea

Extent.—North to south, 275 miles; east to west, 356 miles. Area, 97,914 square miles. Population (1940 census), 250,742.
Natural Features.—Rocky Mountain system, including the Laramie and Medicine Bow ranges in the southeast, the Big Horn Mountains in the north, Absaroka, Owl Creek, Wind River, Teton, and Salt River ranges in the west (highest peak, Gannett, 13,785 feet). Great plains rolling east from the mountains. Principal rivers: Big Horn, Powder, North Platte, Green, and Snake. Yellowstone National Park. Mean annual temperature, 42°; mean annual precipitation, 14″.
Products.—Coal, petroleum; hay, sugar beets, wheat, oats, potatoes, beans; sheep and wool, cattle; lumber and timber products.
Cities.—Cheyenne (capital, 22,474), Casper (17,964).

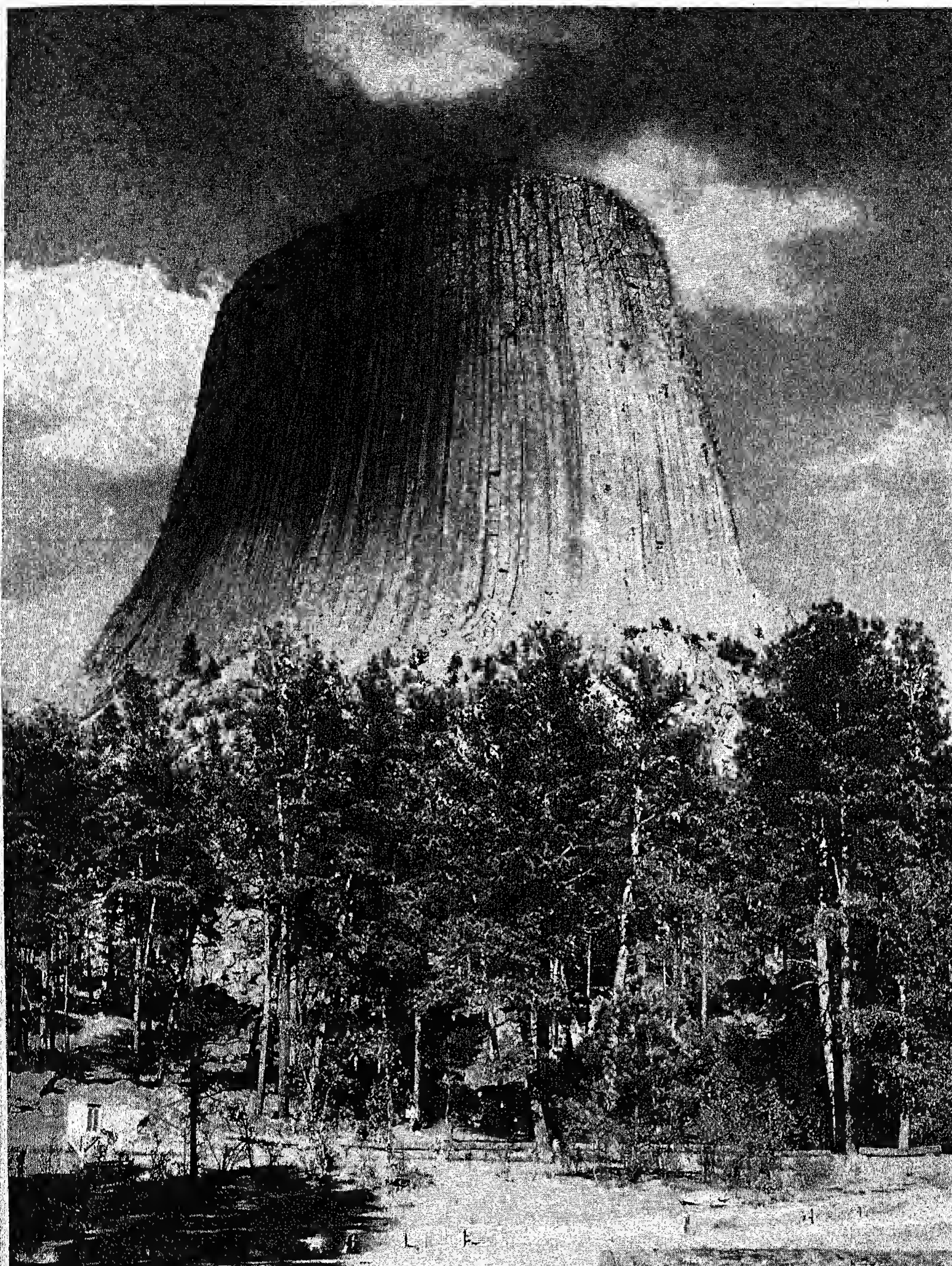
WYOMING. It would require all New England and Indiana to make another Wyoming—a state whose grazing land is equal to the entire area of Kentucky; whose farms exceed in size Massachusetts and Connecticut combined; whose forests cover more territory than the states of Maryland and Delaware; and whose extensive coal and petroleum fields and iron ore deposits give promise that it may some day rival Pennsylvania in mineral production. Yet this magnificent state has little over one-eighth as many people as Philadelphia, though it is more then twice the size of the Keystone State. But the country is yet new. It is scarcely two generations since Buffalo Bill on the western plains was killing as many as 69 buffaloes a day to feed the workers of the Kansas Pacific railroad. And although the atmosphere of the Wild West has now almost completely disappeared, Wyoming is far from the full development of its wonderful possibilities.

It is well known that Wyoming possesses some of the most weirdly beautiful landscapes to be seen anywhere. It contains deep and curiously carved canyons, awe-inspiring cataracts, magnificent cascades, and fantastic monuments. It has petrified trunks of trees still standing, and fossil remains have been dug up of gigantic monsters that in prehistoric times roamed its wilds. There are lakes of soda, enough to raise all the biscuits of the world; poisonous and medicinal hot springs and other mineral waters, enormous extinct geysers, chalk mountains, and painted rocks. In the southwest are examples of the famous "bad land" topography found in South Dakota. Most famous of all are the wonders of Yellowstone National Park (*see* Yellowstone National Park), a district of more than 3,000 square miles in the northwest corner of the state set aside by the national government as "a public pleasure ground and game preserve," which is visited annually by thousands of tourists.

Wyoming has a perfect regularity of outline owing to the fact that its boundaries are entirely meridians and parallels—41° and 45° north latitude and 104°3′ and 111°3′ west longitude. Only one other state—Colorado—has this completely rectangular outline. A cross section of its area, however, would present a very different picture. Lying within the widest part of the Rocky Mountain range—which crosses the state obliquely from northwest to southeast—Wyoming follows Colorado as the second highest state in the Union. From its vast plains detached mountain spurs rise in lofty grandeur, with peaks surpassed in height by few in North America. Here is the continental divide, whence rivers flow north, east, south, and west to the Missouri-Mississippi, the Columbia, and the Colorado river systems. Not all of the state is mountainous, however. The east lies in the great western plain, and between the mountain ranges are wide and often fertile valleys.

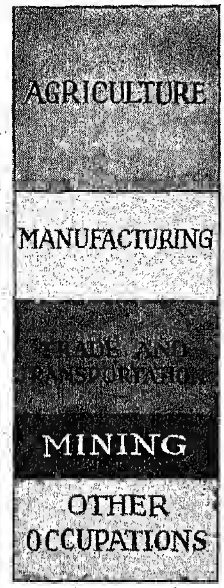
In the Days of the Buffalo

Years ago, when the only inhabitants of Wyoming were redmen, great numbers of buffalo roamed over its luxuriant grassy plains. The first white settlers brought cattle with them, which thrived without care or attention on the nutritious grasses; and for a long time live-stock raising was the only industry in the state. Farms are gradually encroaching upon the



Like a great petrified tree stump, this column of volcanic rock rises 1,200 feet above the Belle Fourche River. It is in the northeastern corner of the state, in the Black Hills region. The tower is 865 feet high from the ridge at its base. The Indians believed that the furrows in its sides were made by bears pursuing maidens who took refuge on its summit. Geologists tell us that it was formed by the upwelling of molten lava, which cooled so rapidly that it shrank and cracked into the form of fluted columns. It was the first national monument (*see* National Parks and Monuments).

THE SURFACE OF WYOMING AND ITS OCCUPATIONS



Broken ranges of the Rocky Mountains divide the surface of the state, with rolling prairies between. The east lies within the Great Plains region. Above we see the relative number of persons employed in various occupations.

range, but more than two-thirds of the soil is thin, and gets only enough moisture to grow grass for grazing. Wyoming is also a leading producer of sheep and wool. Live stock may live in the open all through the winter and fatten on the dry grass, though most ranchers now provide winter feed.

Farming and Irrigation

Dry farming is practised on about a third of the crop land. Two-thirds is irrigated—about a million acres. The largest irrigation project is on the North Platte River south of Casper. Flood waters are stored behind the Guernsey, Pathfinder, Seminoe, and Alcova dams.

In the north central part of the state, near Cody, is the Shoshone Dam, one of the highest in the world. The Wind River project, in the west central section, will eventually reclaim 100,000 acres. Many more millions could be reclaimed because the abundant snows in the higher mountain ranges supply ample water to the rivers. But only about 15 per cent of the water is now utilized. On irrigated land the chief crops are alfalfa, sugar beets, beans, corn, potatoes, wheat, and oats. Turkey raising is a profitable side line, and dairying is increasing.

Developed and Undeveloped Mineral Riches

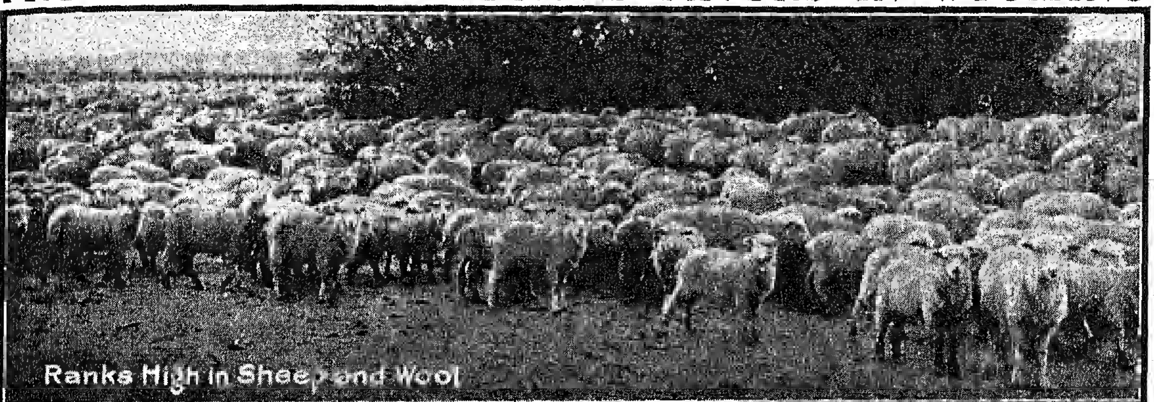
Disappointing yields of gold, silver, and copper obtained by early prospectors led to the belief that Wyoming was poor in mineral resources. Later discoveries made Wyoming one of the richest states in the country in coal and oil reserves. Coal underlies at least a third of the area. Petroleum accounts for almost half the total value of mineral production. Teapot Dome, a naval oil reserve, is about 50 miles north of Casper. Valuable deposits of vanadium lie in Sublette Ridge in the southwest. Other important products are natural gas and natural gasoline, iron, bentonite, limestone, sodium sulphate, potassium salts, vermiculite, tantalum, and feldspar.

Industries and Cities

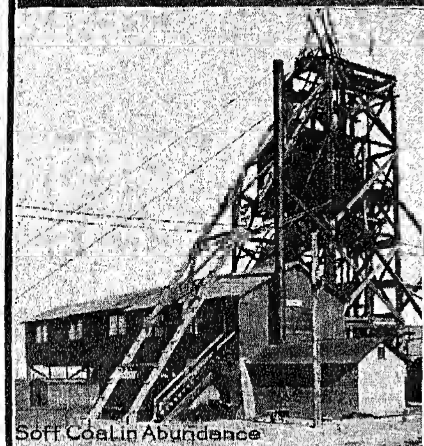
Refined petroleum is the leading manufactured product, followed by lumber, butter, flour, and meat. One of the most profitable enterprises is dude ranching, including the organization of camping trips into the mountains for hunting and fishing. The dude ranches entertain more than 10,000 guests every year. Several hundred thousand tourists a year visit Yellowstone and Grand Teton national parks, the Jackson Hole country, Devils Tower, and Fort Laramie (*see* National Parks). They spend as much as $25,000,000 annually—more than is derived from petroleum refining.

Cheyenne, the capital and largest city, is one of the chief cattle centers of the West. Its annual Frontier Days' Celebration revives the life of the "Old West." Cheyenne citizens dress up in traditional costume; the Sioux Indians come in from the reservations to dance; and professional cowboys and cowgirls participate in the rodeo contests. Cheyenne is in the southeastern corner of the state, about a hundred miles north of Denver. It has large railroad and airplane repair shops and an oil refinery.

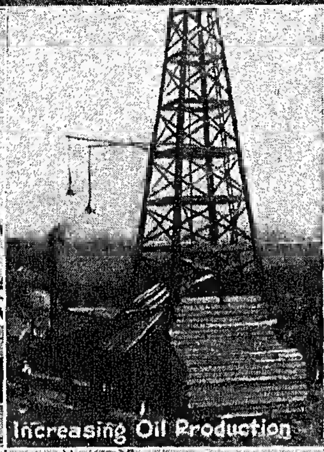
PROFITING FROM NATURE'S FAVORS IN WYOMING



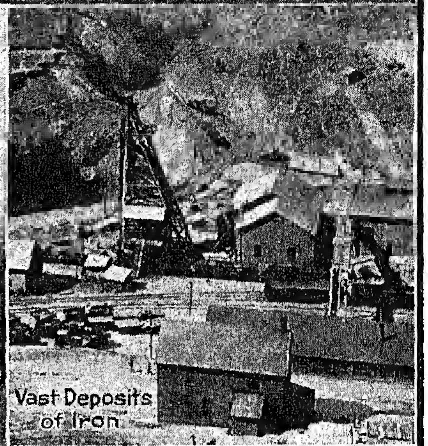
Ranks High in Sheep and Wool



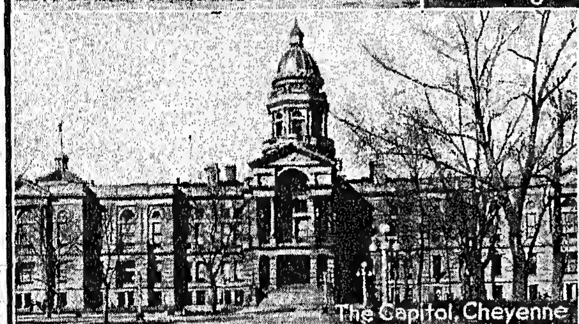
Soft Coal in Abundance



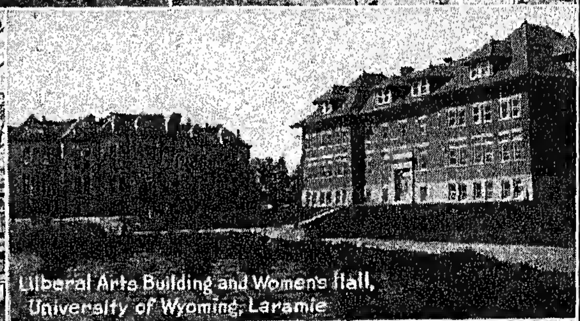
Increasing Oil Production



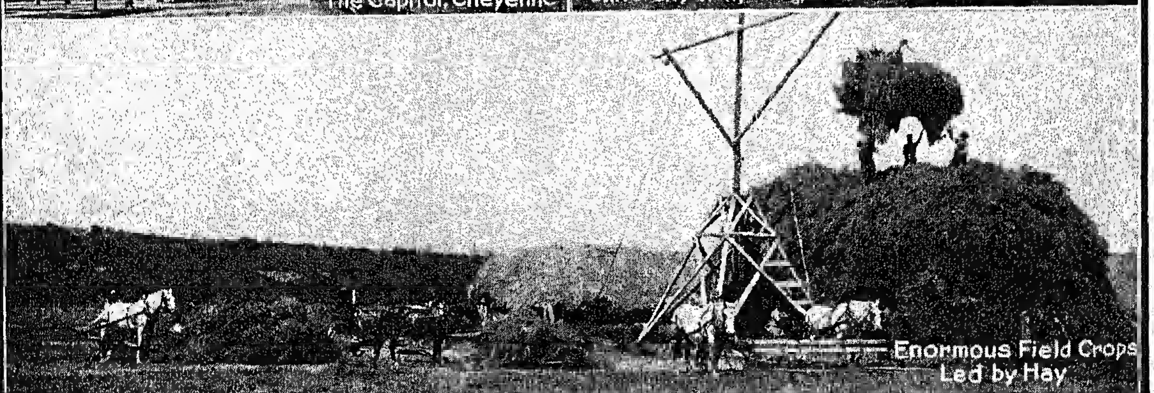
Vast Deposits of Iron



The Capitol, Cheyenne



Liberal Arts Building and Women's Hall, University of Wyoming, Laramie



Enormous Field Crops Led by Hay

Wyoming's early development was as a cattle grazing state. Later large areas were taken over for sheep grazing—an innovation which the cattlemen resisted bitterly at first, because sheep graze so closely that cattle cannot live on the same range. The last few years, however, have seen a great change. Farming and the exploitation of the state's vast mineral resources, notably petroleum, have become the leading industries, and sheep and cattle raising have dwindled. The dignified Capitol and the fine buildings of the State University typify the public spirit of the state.

Located on a plateau more than 6,000 feet above the sea, the city enjoys a healthful climate.

Smaller than Cheyenne is Sheridan, near the center of the north boundary of the state, which lies in the midst of valuable irrigated lands. Like Cheyenne it is important as a live stock center, and has deposits of coal in the vicinity. Laramie, 57 miles northwest of Cheyenne, is a popular summer resort, being situated on the plains close to the mountains. In addition to being the shipping and trade center for a large stock-raising and mining section, it has many factories, including rolling mills, plaster mills, planing mills, and railroad and machine shops, a large oil refinery, and the state university. Casper, situated in the center of the state, is the second town in point of population. It is a stock-raising center, but the rapid growth of the last few years has been caused by the erection and operation of huge oil refineries employing large numbers of men.

Brilliant and continuous sunshine makes the climate of Wyoming healthful and pleasant, and the dry air causes the extremes of temperature—100° above to 36° below zero—to be felt less keenly. With an average precipitation of only 14 inches, the state is one of the most arid in the Union.

Wyoming came to the United States as part of the Louisiana Purchase. Only a few explorers had crossed its present boundaries before the 19th century, but from the days when Fremont's expedition explored the Wind River Mountains and the South Pass, in 1842, the favorite route to the Pacific led through southern Wyoming. Of all the thousands who passed on this famous "Oregon Trail," however, few or none settled permanently, because of the aridity of the land and the hostility of the Sioux and other Indians. A Mormon settlement was made on the Green River in 1853, but was abandoned in favor of Salt Lake City in 1857. Gold was discovered on the Sweetwater River in 1867, and a large inrush of population followed, leading to the founding of South Pass City. In the same year Cheyenne was laid out by the Union Pacific Railroad Company, Laramie followed in 1868, and both towns were populated almost immediately.

In 1868, Congress established a territory within the present boundaries, taking the land east of the Rocky Mountains from Dakota and that west from Utah and Idaho. The first legislature met in 1869, and granted full suffrage to men and women. The history of the territory was marked by many Indian wars, in one of which Gen. George A. Custer and 208 men of the United States Army were killed on the Little Big Horn in Montana in 1876. These wars lasted until the Indians, led by Sitting Bull and Rain-in-the-Face, were finally subdued and confined to reservations. In 1890, Wyoming was admitted as a state.

XAVIER (*zăv'ĭ-ẽr*), Saint Francis (1506–1552). In the long and glorious annals of Christian missions there is no more inspiring page than that which tells of the devoted labors of Saint Francis Xavier, the "Apostle to the Indies." The hardships he underwent in 11 years of incessant travel through India, the East Indies, and Japan, and the results he achieved in carrying the Gospel to remote regions where the name of Christ had never before been heard, give ample warrant for the view that he should be regarded as the greatest of Christian missionaries since the first century A.D. It is said that his travels in heathen lands covered 50,000 miles and that he baptized more than half a million persons.

A gifted youth, the youngest son of a noble family of Spanish Navarre, he began his studies in 1524 at the University of Paris, where after a few years he became a lecturer. Love of learning and love of pleasure occupied his thoughts until he met Ignatius Loyola, the founder of the Jesuit order, who often quoted to him the words, "What shall it profit a man if he gain the whole world and lose his own soul?" Loyola's solemn pleadings sank into Francis' heart and led to his determination to devote his life to holy things. He was one of the little group of earnest spirits who, under Loyola's leadership, founded the Society of Jesus in 1534. (*See* Loyola, Ignatius de.)

Francis Xavier was ordained a priest in 1537; he studied medicine, tended the sick in hospitals, and preached wherever men would listen to him. In 1541 he began the missionary career in which he spent the remaining years of his life, being sent with the rank of papal nuncio to preach the Gospel in India. On the way he lived among the common sailors, ministering to their spiritual needs and caring for them during an attack of scurvy. Landing at Goa, on the west coast of India, he labored there for several months, then began a series of remarkable journeys which covered the whole of India, the scattered islands along the coast, Malacca, and the Moluccas or Spice Islands far to the east. Finally he went to Japan, where he remained more than two years, penetrating into all parts of the country, winning many converts to the faith. His next plans were for the conversion of China, but he fell ill of fever on the way and died on the island of Sancian, near Canton, at the age of 46. He was canonized in 1621 by Pope Gregory XV as Saint Francis Xavier, and December 3 was fixed as his feast day.

XENOPHON (*zĕn'ō-fŏn*) (about 430–355 B.C.). To the boy or girl who studies Greek, Xenophon always means first of all the author of the 'Anabasis', in whose pages we read of the "upward march" (Greek, *anabasis*) and long and trying retreat of the famous Ten Thousand Greeks who entered the service of the unfortunate Cyrus the Younger, against the king of Persia. To us also comes a thrill as we read the cry, *Thalassa! Thalassa!*—"The sea! The sea!" with which the worn and wearied band, heroic in defeat, greeted at last the saving waters which should carry them home again.

This expedition, of which Xenophon was a member and the historian, set out in 401 B.C. He was an Athenian, and had been a pupil of Socrates, whose life he is said to have saved in the battle of Delium. When he returned to Athens in 399, he found his old teacher condemned to death, and wrote the '*Memorabilia*' (Recollections of Socrates) to clear the memory of the great philosopher of the charges on which he was executed.

For a time Xenophon even served Sparta in war against Athens, so great was his wrath at his native city. For 20 years he lived on an estate in Elis, given him by the Spartans, there busying himself with agriculture and literary work.

Besides the 'Anabasis' and 'Memorabilia', Xenophon's chief works are the 'Hellenica', a history of Greece from 411 to 362 B. C., and the 'Cyropedia', a political and philosophical romance in which he describes the education of Cyrus the Great, king of Persia.

XIMENES (*zĭ-mē'nēz*) **DE CISNEROS**, Cardinal (1436–1517). At the very time when Isabella of Castile was aiding Columbus to set out upon his memorable voyage, she was also raising from obscurity a monk who wore the humble habit of the Gray or Franciscan friars. For many years this tall gaunt friar had been leading a life of severe asceticism in an obscure monastery, and the fame of his penitential life and great holiness had traveled wide. In 1492 Queen Isabella called him to her court and appointed him Royal Confessor; and although he was then 56 years old, he rose rapidly to a pinnacle of greatness to which few can aspire.

Educated at the university of Salamanca, Francisco Ximenes, or Jiménez (*hē-mā'nāth*, as the Spaniards write and pronounce it), spent several years of his early life at Rome, and then returned to Spain to receive an appointment given him by the pope. But the archbishop of Toledo refused to recognize the

pope's grant, and became so incensed at Ximenes' insistence that he cast him into prison, where he remained for six years. Released from prison, he gained an important position in the church, but soon renounced it to enter the order of Franciscans.

Upon the death of the Cardinal-Archbishop Mendoza of Toledo (not his former enemy) in 1495, the Queen secured from the pope the appointment of Ximenes to this post, the richest and most powerful in the whole Spanish church. Ximenes at first refused the position, for he did not desire earthly honors, but finally accepted it after receiving express orders from the pope. Twelve years later he was also made cardinal. As archbishop of Toledo he applied himself seriously to reforms among the clergy and religious orders; and although maintaining the outward forms of splendor which his position demanded, continued to lead the simple life of a Franciscan friar.

Shortly after his accession be began to devote himself to the chief aim of his existence, the conversion of the Moors. His stern methods were attended with considerable success, and in 1505 he extended his efforts to Africa, himself leading a brilliant expedition which in one day took the city of Oran. Since the death of Isabella, in 1504, Ximenes had played a considerable part in the government of Castile; and on the death of her husband Ferdinand of Aragon, in 1516, he became regent of all Spain for the young king Charles (*see* Charles V). In the two years during which Ximenes held this position he showed himself a bold and determined statesman. He established a standing army by drilling the citizens of the principal towns, increased the maritime power of Spain, and yet paid off the national debt.

Ximenes will probably be best remembered, however, for his founding of the great University of Alcala in 1508; and for his famous "Complutensian Polyglot" Bible, which was printed there at his expense, on the plan of exhibiting in one view the scriptures in their various ancient languages. This contained the first printed text of the original Greek of the New Testament, although it happened that the Greek edition annotated by the Dutch scholar Erasmus was the first published (*see* Bible).

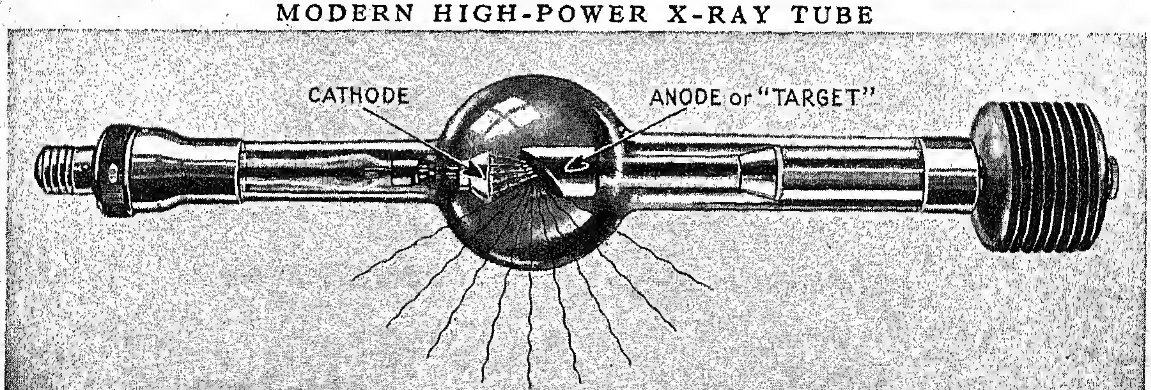
RAYS *that* SHOOT *Through* SOLID MATTER

The Mysterious Streams of Energy by Whose Power We Can See Into the Human Body—Their Discovery by Professor Roentgen, and How They Are Used in Medicine and Other Fields

X-RAYS. The use of "X," symbol of the unknown, in the name of these rays which can reveal conditions inside living bodies, and can detect flaws buried deep in solid metal castings, is thoroughly appropriate. Although we now have definite ideas concerning the nature of these rays, for many years after their discovery—even while they were being used the world over in medicine and science—their nature was a mystery. Moreover, even now when we understand them better, much that they do seems so uncanny that the term "X" seems quite appropriate for these rays.

The story of these fascinating rays started about the middle of the 19th century, when Heinrich Geissler (1814–1879) and others found that discharging electricity under high voltage through tubes containing a partial vacuum produced beautiful light effects. The most fruitful investigations made upon this effect were those of Sir William Crookes (1832–1919). He obtained high vacuums in his tubes, and by using concave cathodes (the cathode is the electrode by which current leaves the tube) and metal screens and slits within his tubes, he obtained beamlike effects

MODERN HIGH-POWER X-RAY TUBE



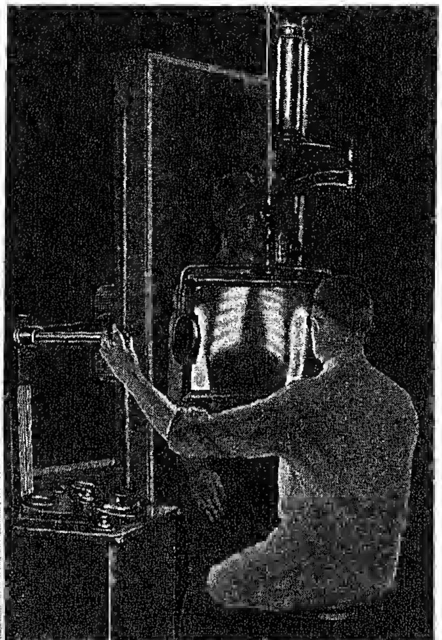
The cup-shaped cathode focuses a stream of electrons, called the cathode rays, against the heavy tungsten target. This causes the target to produce the penetrating X-rays which come out through the glass of the tube. A Coolidge tube of this kind is made with the highest possible vacuum, and the electrons have to be supplied by a filament situated behind the cathode and heated, like the filament of a radio tube, by an independent low-voltage current. The potential between cathode and anode which drives the electron stream often exceeds 100,000 volts, and in special types exceeds 1,000,000 volts. The finned radiator at the right helps to carry away the intense heat generated on the target by the impact of the electrons.

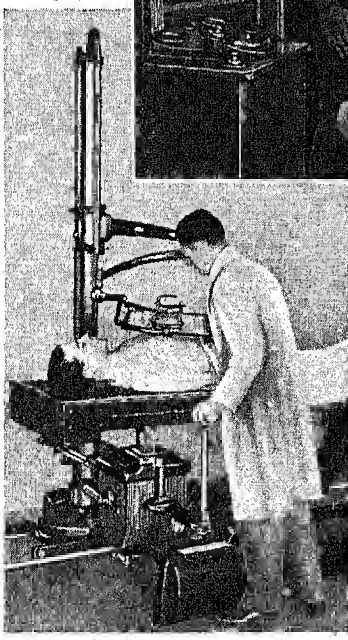
which indicated that the luminosity was caused by electrified particles streaming from the cathode. Heinrich Hertz (1857–1894) showed that Crookes' "cathode rays" would pass through thin sheets of gold or platinum, and his pupil P. E. A. von Lenard added "windows" of such substances to the Crookes' tube, so rays could pass through to the outer air.

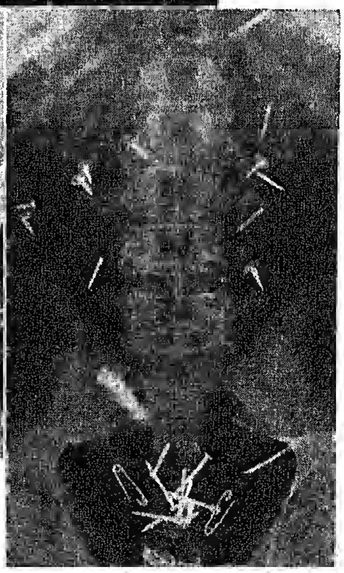
Thus the stage unwittingly was set for the discovery, in 1895, of the X-ray. In that year Prof. Wilhelm Roentgen (1845–1923) of Munich, while experimenting with a Crookes' tube, noticed that some near-by crystals of barium platinocyanide were glowing brilliantly. Knowing that cathode rays themselves could not pass through the glass to produce this effect, he immediately suspected that some other kind of rays was present. He exposed photographic plates near the tube and found they became fogged. Plates wrapped in black paper were affected just as if no paper were around them. Astonished by this result, Roentgen decided that here was an invisible ray, hitherto unknown, differing in important respects both from the cathode ray which produced it, and from light. He named this newly discovered form of radiation "X-rays"—the "rays of unknown nature." Later on scientists called them Roentgen rays, a name still largely used in Europe.

The story of Roentgen's amazing discovery spread over the world immediately by telegraph and cable. Its medical value was at once recognized when experiments showed that these rays would penetrate flesh, and the use of X-rays in this and other fields developed amazingly, as will be told later. Meanwhile scientists attempted to learn what these mysterious rays might be; but it was not until 1912, when investigators obtained X-ray spectra by using crystals, as will be explained later, that scientists considered the problem as at all settled. But meanwhile discoveries in other fields were strongly suggesting the answer, based on the nature of cathode rays.

HOW DOCTORS "SEE THROUGH" A MAN







A fluoroscope examination is shown in the upper picture. The X-rays coming through the man's body from behind throw shadows of his bones and organs on the fluorescent screen. At the left is a movable X-ray table being used for a fluoroscope examination. The X-ray tube is in the movable housing underneath, shielded with lead so the rays can escape only through the small opening. In making a radiograph the tube is placed over the patient and the photographic film contained in a special holder is slid into position under the table. At the right is a radiograph which shows the strange taste of a small child for tacks and nails. It shows the stomach and intestines after the child spent an afternoon playing with the things found in the family toolchest as the X-ray showed them.

Cathode rays, many investigators found, are not rays like those of light or radio, which have wavelike characteristics. They consist of billions of electrons—particles of matter, electrical in nature—fired from the cathode through the space in the tube to the anode, in response to the high electric potential differences used. The early experimenters found that this stream of electrons could be deflected by near-by magnets. Since light beams were not so affected, this led scientists to suspect that cathode rays consisted of electrically-charged particles. These particles or electrons moved, they decided, from the cathode to the anode at speeds controlled by the voltage of the current and the degree of vacuum in the tube. Speeds up to 150,000 miles a second were attained in powerful tubes. (The use of terms like anode and cathode, implying the use of direct current, and the fact that alternating current devices, such as Ruhmkorff coils, were often used to actuate the tubes, is not really a contradiction. The effective part of the current so obtained was the higher-tension, single-direction current generated on the "breaks" of current in the primary of the coil.)

From these facts, and expanding knowledge of radioactivity (*see* Radium and Radioactivity), it was easy to suppose that when these flying electrons struck the atoms of the target, some of the target's atoms were

disrupted momentarily, and electrons were jarred loose. These electrons could be supposed to fall back again, while the electronic disturbance would cause radiation into space in a form akin to light. The fact that X-rays were invisible to the eye could be explained by saying that their wave-length was much shorter, lying between the wave-lengths of ultra-violet and that of radium gamma rays (*see* Radiation). This supposition was strengthened by the fact that X-rays, like light waves or rays, were not deflected by magnetic fields.

X-Ray Spectroscopy

The problem was considered settled, at least in broad outline, by the work of the Braggs, von Laue, and Moseley, with first results announced in 1912. They found that X-rays falling upon crystalline substances were diffracted. This was acceptable proof that X-rays were radiant energy like light and not streams of electrons like cathode rays. Under suitable conditions these diffracted rays can be focused on a photographic plate, where they produce patterns as characteristic of the crystalline substances used as are the patterns furnished by the spectroscope (*see* Spectrum and Spectroscope). These patterns depend upon the atomic structure of the substance, and by carefully measuring and analyzing them, scientists have been able to learn much about atomic arrangement. This method of analyzing the structure of substances is called "X-ray spectroscopy."

Since then many puzzles have arisen; but the explanation given will serve for an elementary understanding of what X-rays are, and no definite answer to problems of more advanced nature could be given in simple terms, for practically every answer suggested is open to question in one or more respects.

Why X-Rays Penetrate Objects

Practical uses of X-rays turn largely upon their penetrating power, which is shared to a lesser degree by the longer ultra-violet rays and to a greater degree by the shorter cosmic rays. This penetrating power of X-rays can be demonstrated by the same phenomenon that led Roentgen to discover them. Certain chemicals have the quality of *fluorescing*, or glowing, when X-rays strike them. If a plate covered with calcium tungstate or zinc sulphide, for instance, is held on one side of a human hand, and an X-ray tube is operating on the other side, the bones of the hand will be outlined on the plate as shadows. Such a device is known as a *fluoroscope*. The X-rays do not penetrate the denser bone structure as intensely as they do the flesh, and consequently the bones show up as shadows on the plate. Another way to demonstrate this penetrating power is the other method used by Roentgen—permitting the X-rays to fall on a photographic plate after passing through the subject. These plates are sensitive to X-rays as well as to visible light, and when developed disclose a shadow picture, called a *radiograph*, of the subject.

The density of a substance determines the depth to which X-rays will penetrate it. The rays pass readily through organic tissues such as flesh, the soft green tissue of plants, and smooth-grained wood, because the molecules and atoms forming them are packed loosely, making it easy for the short waves of the X-rays to pass between the particles. Other substances such as bone, teeth, and knots of wood, have a closer structure and the rays are partially blocked. Substances like rock and metal offer still greater resistance. Some materials, like lead, platinum, iridium, osmium, and uranium, are so dense, the molecules being so closely packed, that the X-rays pass through them only if the metals are in thin sheets. Consequently these materials are used as shields to block the passage of X-rays.

X-radiation consists of waves of widely differing attributes. Long or so-called "soft" X-rays do not penetrate things as easily as the shorter or "hard" rays. The faster the speed of the electrons fired from the cathode of the tube the more powerful are the X-rays produced.

How X-Rays Help Doctors

The chief use of these wonderful X-rays is to enable physicians, surgeons, and dentists to examine the inside of the body in diagnosing disease. A modern doctor, wishing to know, for example, the exact facts about the digestive condition of a patient, gives him an *opaque meal* of a harmless bismuth or barium compound. This inert material is so dense to the X-rays that it shows clearly on both the fluoroscope and the radiograph. The shape and position of the stomach and intestines can plainly be seen as this opaque meal moves through the body. By a series of pictures, taken at intervals, the passage of food and the muscular processes may be watched and the doctor can detect any malposition or abnormality of the organs or functions. Diseased tissues often reveal themselves by characteristic appearances under the X-ray. X-rays also help surgeons, especially when the operation is a case of bone injury, or involves removal of bullets or other opaque objects.

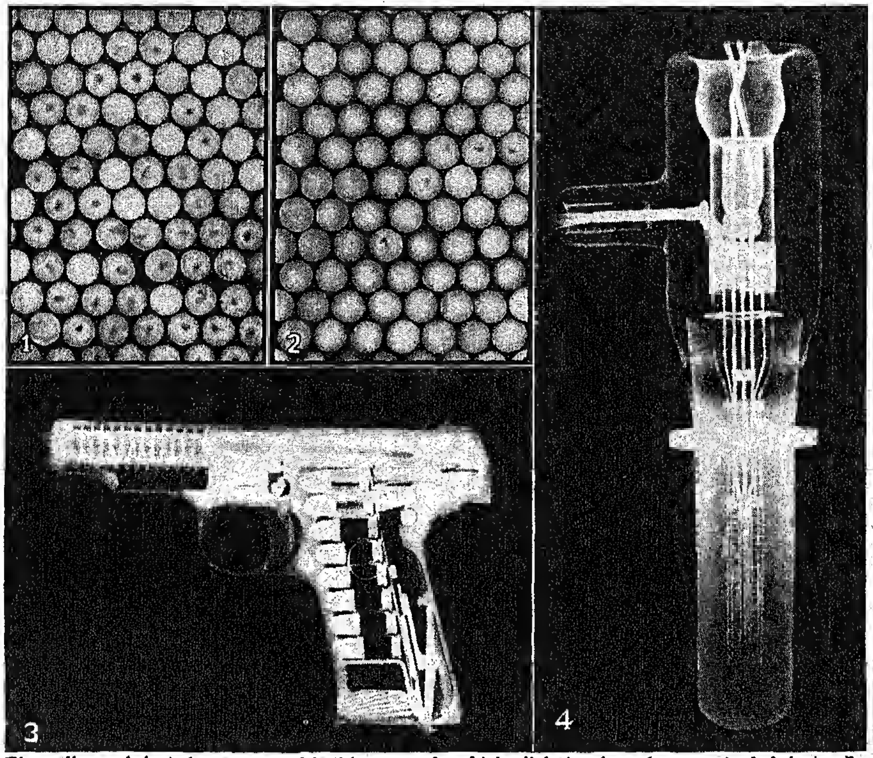
Dentists take X-ray pictures to determine the condition of teeth and jaws. They help to find abscesses and other infections, to decide exactly which teeth should be pulled or treated, and often provide information far in advance of warning pains in the tooth itself. By long experience roentgenologists are able to detect abnormalities in deeply seated organs merely by the slight differences in the shadows made by them. Stereoscopic views showing depth are an important development.

For some time after the discovery of X-rays it was not fully understood that they have profound and marked effect on living tissues. This has been both a benefit and a grave danger. On the one hand, they have been used to destroy cancer tissue and to treat other diseased conditions; on the other hand, when applied too long or too intensely they have caused great damage. In the early days, many of those who experimented with X-rays were overtaken, months and even years later, by the effects of the "burns,"

usually in the form of skin cancers on hands, arms, and face. Today, fortunately, it is possible to minimize and in most cases entirely avoid these dangers, both by surrounding the X-ray apparatus with metal shields and by regulating the time, intensity, and extent of the treatment or exposure.

Perhaps the most extraordinary effect of these rays on living matter has been demonstrated by experiments on seeds of plants and eggs of animals. The coloring of flowers and the shape of leaves grown from such seeds have been altered. Eggs so treated have resulted in monsters and abnormalities, or "mutations," indicating a mysterious effect of X-rays upon the very foundation of living matter.

THE DETECTIVE OF INDUSTRY



The radiograph in 1 shows a tray of ball bearings in which all but a few show marked defects. In 2 the *manufacturing process has been improved to a marked extent and the number of defective* bearings reduced. In 3 is shown an automatic pistol, loaded and ready for use. If there was a faulty adjustment of the mechanism the radiograph would reveal it. In 4 is shown a radio transmission tube such as used by broadcasters. The upper half is glass and the lower half copper. The arrangement of grid and other hidden elements can easily be seen. Inspection by any other method would be impossible as it would mean dismantling the assembly.

Industrial Uses of X-Rays

Outside of medicine and surgery the field for utilizing X-rays is continually expanding. Especially is this true in industry, where they are used to inspect the internal quality of products. For instance, manufacturers of vacuum tubes examine the assembled tubes to determine if the delicate hidden parts are in correct position and the lead-in wires properly sealed. X-rays will reveal inner cracks, blowholes, cavities, and strains in castings, and are being used to improve foundry practise. Radiographic testing of castings for airplane and automobile motors is now general, not only for safety but to avoid machining and grinding a casting that would prove to be flawed at some later operation. Imperfect welds can be easily detected by X-rays. Radiographic tests are now employed to examine automobile tires for imperfect binding between the tread and the cords. X-rays will also show up foreign metallic bodies embedded in reclaimed rubber. Similar methods are used on other rubber products such as molded pieces, as well as on bakelite and condensite parts with metal inserts or internal seals, to examine them for faulty fabrication. In electrical apparatus, X-rays will show broken conductors inside insulated wires, and bring to light air bubbles or foreign metal bodies that might cause failure in operation at high voltages. In short, the X-rays provide the only means of definite inspection analysis short of actual destruction or actual use.

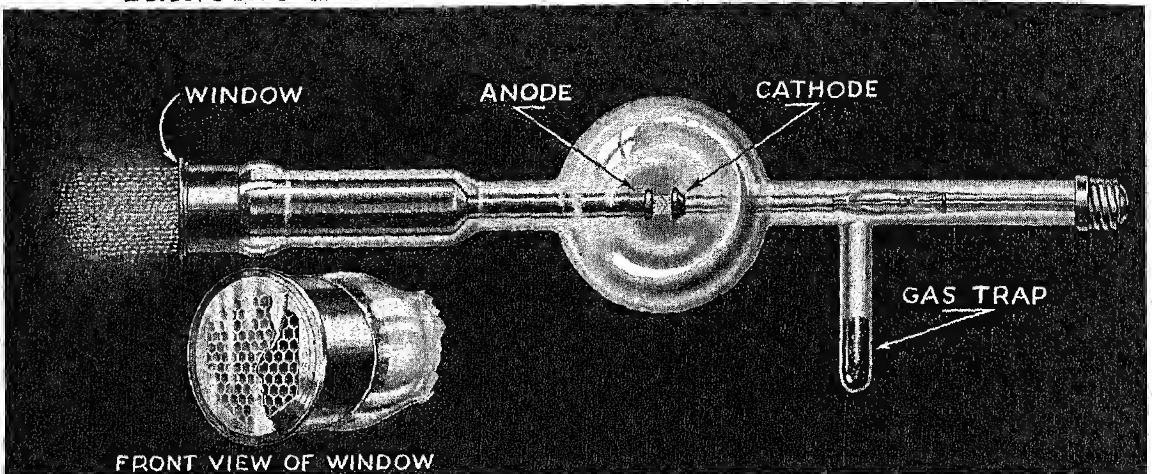
Coal is examined for percentage of slate and other impurities. In the field of art, the underlayers of old paintings can be inspected to determine authenticity, and detect possible retouching or alterations. Sculpture, inlays, and furniture offered to collectors and museums as antiques can often be classified by this method, and many frauds that formerly deceived the best experts have been uncovered. Police and customs inspectors use X-rays for searching out stolen or contraband articles concealed in baggage or in bales of innocent merchandise.

In the field of scientific knowledge X-rays have been of incalculable benefit. The shortness of the waves, which permits them to slip through between the atoms of substances, has been of far-reaching importance in discovering many things about these atoms—how they are arranged in molecules to form the various chemical compounds, and how the molecules in turn give shape to crystals.

Developing More Powerful X-Rays

Progress in the technique of using X-rays has been rapid. Early limitations of the power due to the relatively low voltage obtainable with the old-time induction, or Ruhmkorff, coil was overcome by the development of modern transformers (*see* Electricity; Transformer) capable of stepping up current to enor-

BRINGING A STREAM OF ELECTRONS INTO THE OPEN



With this 350,000-volt cathode ray tube W. D. Coolidge has succeeded in producing a stream of electrons in the air. Electrons are supplied by a tungsten filament back of the cathode, and they are projected with tremendous force through the anode toward the window end of the tube, where they pass through the nickel foil with only a slight diminution of their estimated velocity of 150,000 miles per second. The foil window is supported against the outside air pressure by a honeycomb grating, and the end is water-cooled. A gas trap filled with charcoal absorbs the products generated by the terrific heat.

mous voltages, so that now X-ray tubes are often operated at potentials well over a million volts. Another defect, the tendency of the target to melt under the heat generated by the bombardment of electrons from the cathode, has been obviated chiefly through the work of Dr. W. D. Coolidge, of Schenectady, in producing massive anode targets of tungsten, which have the highest melting point of any metal. Standard Coolidge tubes can be operated at voltages up to 350,000 and yield intensely hard X-rays capable of penetrating from 5 to 6 inches of steel. This tube has the highest vacuum obtainable—so high that the electrons for the cathode rays have to be fed into the tube by a glowing filament in the same way that the electron steam is produced in a radio tube (*see* Electronics).

The prospect of much higher voltages for producing X-rays was opened by the announcement in 1931 that Dr. Robert J. van de Graaff, at the Massachusetts Institute of Technology, had devised a new method of accumulating electrical charges. Silk belts driven by electric motors passed over pulleys inside large aluminum spheres. Static electricity forming on the moving belts was collected in the spheres until charges of 15 million volts or more were built up.

The next important step was the development of the *betatron* or *rheotron* in 1941. This instrument was originated by Dr. Donald W. Kerst at the University of Illinois. It consists of a large doughnut-shaped vacuum tube in which a stream of electrons is whirled around by the action of powerful electromagnets. The electrons reach a speed very close to the velocity of light, and, from some of the earlier models, effective energies of more than 100 million volts were drawn for X-ray production and other purposes.

Other Effects of Cathode Rays

Along with the development of the more powerful X-rays has gone the development of tubes of the Lenard type for bringing cathode rays out into the open. An accompanying picture shows such a tube.

Bombardment by cathode rays thus produced has a profound effect upon many substances, often disrupting their structure and changing their form. It converts some solids to gases or fine powders, sometimes changing their color, and makes some colorless crystals fluoresce even after the bombardment ceases, although they stay cold. It destroys living organisms.

'XYZ' AFFAIR. In the conflict between England and France, during the French Revolution, France had confidently expected that trouble with England over the seizure of their ships would lead the United States into war. The revolutionary statesmen were bitterly angered, therefore, when in 1794 matters were arranged for the time being by a treaty. The French government, the Directory, declared that the United States had not kept its agreement with them; and they insultingly refused to receive the American minister Charles C. Pinckney, and began to seize American ships.

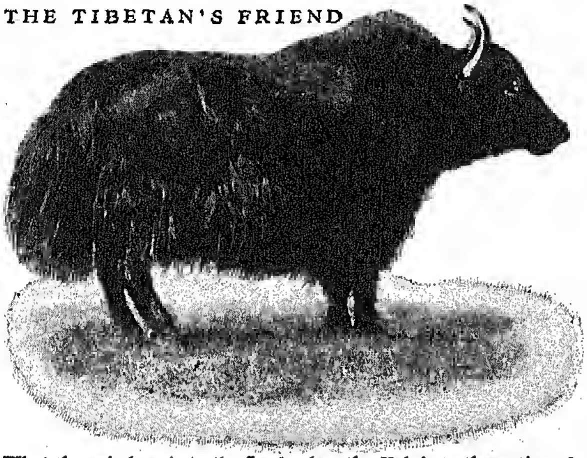
When John Adams became president, in 1797, he was anxious to avoid war, and so sent three agents—Elbridge Gerry, Pinckney, and John Marshall—to France to settle the difficulty. They were met finally by three French go-betweens (designated in the American despatches as X, Y, and Z), who demanded a gift of $250,000 to Talleyrand, the French foreign minister, and a loan of $10,000,000 to France as a preliminary to negotiations. When this became known through publication of the despatches, the United States was so angered that war existed for a time. Then France gave in and the matter was settled by treaty in 1800.

It was during this affair that Pinckney is said to have uttered the much quoted phrase, "Millions for defense, but not one cent for tribute." Another version gives his reply as "No, no, not a sixpence."

YAK. No large animal habitually lives at greater heights than this member of the ox family, which is found in a wild state on the high plateaus of Tibet between the Altai and Himalaya Mountains.

It is about the height of a small ox and can at once be distinguished by the long hair which hangs from each side like a curtain, in some cases touching the ground. The color of the wild animal is black, but some of the domesticated breeds are black and white; and the hair is longer in the domesticated than in the wild forms. The tail also is very hairy, and the white tips are cut off by the Chinese, who dye them red and use them as tassels. In India they are used as fly-snappers. There is a hump over the forelegs and this is exaggerated by the hairy mane.

THE TIBETAN'S FRIEND



What the reindeer is to the Laplander, the Yak is to the native of Tibet. Not only is it the sole beast of burden that can survive at such heights, but it provides also food and clothing.

The yak has been domesticated for centuries in Tibet and forms a great part of the natives' wealth. Its milk is rich and the curd is much used both fresh and dried; it makes excellent butter, which is preserved for a long time in bladders, and forms an important article of commerce. The flesh, too, is of fine quality and is often dried and eaten raw. The hair is spun into ropes and made into tent coverings, and the soft fur on hump and shoulders is woven into cloth. The skin with the hair on is used for caps, coats, and blankets. Domesticated yaks are used as beasts of burden and as draft animals, and work well in spite of scanty forage. Scientific name, *Bos grunniens*.

YANGTZE (*yäng'tsĕ*) RIVER. "Ta Kiang" (or Great River) is the name which the Chinese usually give to their longest and most important waterway, which ranks among the great streams of the world. "Yangtze Kiang" (*kiang* means river) as used by them refers only to the lower part, and the other portions have different names. From its source in the Kunlun Mountains of Tibet to its mouth in the East China Sea, this great river traverses the center of the country from east to west for a distance of some 3,000 miles, forming with its many connecting canals and rivers a highway of communication unparalleled in the world. Its basin of about 500,000 square miles includes the greater part of China proper.

The great cosmopolitan city of Shanghai, the commercial outlet for the whole of the basin, is situated 12 miles south of the mouth of the river. Here you may begin your trip up the river in a large ocean steamer, and will not have to change ships until you reach Hankow, an inland port that is nearly as far from Shanghai as Toledo is from New York. At its mouth the Yangtze River is 30 to 40 miles wide, and for a considerable time land is not visible. But finally you see the seaport of Chinkiang on the north bank, and after several days' journey through one of the most beautiful garden spots in the world, arrive at Hankow. The Hankow district is the commercial heart of China, and contains an amazing population (*see* Hankow). Every square yard on the shore seems to be the home of some family, and thousands of people spend their entire lives on the river in junks, houseboats, and "sampans."

Above Hankow the volume of water diminishes greatly, but by changing to a river steamer one may go 500 miles farther inland through a lake-studded country flanked with rich agricultural lands on either side. In flood times the lakes on the course of the Yangtze take much of its surplus water so that, unlike the Yellow River, it rarely causes death and destruction. Above Ichang steam navigation ceases, for here are the famous Yangtze gorges and rapids, which continue throughout most of the great bow-like trend to the south. This is by far the most beautiful part of the river, if we except its upper course in Tibet. The Chinese, by using great gangs of coolies, sometimes haul small boats 500 miles above Ichang. In its lower course the river is not so rapid, and carries in suspension a vast amount of silt, which it deposits in the Yellow Sea at an estimated rate of 6,000,000,000 cubic feet a year.

YANKEE. Best known of all national nicknames, perhaps, is "Yankee"; yet the origin of this famous name for Americans is a mystery. Scholars once thought it came from *Yengees.* That was supposed to have been the way the American Indians pronounced *English,* or its French equivalent *Anglais.* Now there is a theory that a Dutch nickname *Yankey* is the source, because as early as 1683 it was used by Dutch sailors. *Yankey* may have been derived from *Janke,* a diminutive of the Dutch name *Jan* (John).

In America, in Colonial times, New Yorkers rather scornfully called New Englanders "Yankees." During the Civil War, Southerners spoke of all Northerners as Yankees. In the World War, Europeans called United States soldiers "Yankees," or "Yanks," and the term gradually became popular as a nickname for all Americans. Today, in the United States, there is no stigma connected with its use, and the nickname is borne with good humor and even with pride.

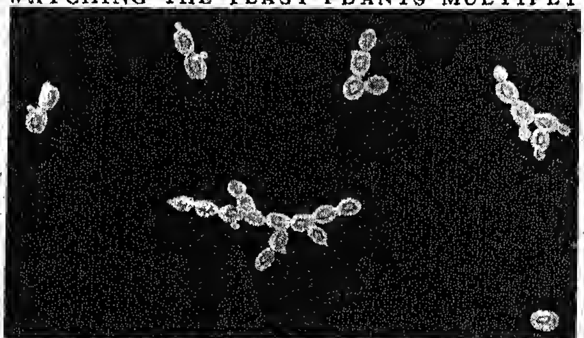
The origin of "Yankee Doodle" is also uncertain. The sprightly, impudent tune appeared in America late in the 18th century as an instrumental air. It was a favorite march of Revolutionary troops and is now regarded as a national air. No authorship has been determined for the numerous verses. Historians believe, however, that most of them originated in the United States. The most famous verse runs:

Yankee Doodle came to town
Riding on a pony,
Stuck a feather in his hat
And called it Macaroni.

"Macaroni" was the name given to English dandies who dressed foppishly. The theory that the verse was written by a British army surgeon to deride American Colonial troops has been generally discarded.

YEAST. Among the smallest of all living things are the one-celled fungi called yeasts—tiny plants invisible except to the eye of the microscope. Like all plants and animals, they need oxygen to live and grow. But yeast plants do not have to get their oxygen from the air. Their tiny bodies contain what is called a *ferment,* or *enzyme.* This enables the yeast plants to extract oxygen from almost any substance that contains sugar. When they do this, they bring about chemical changes called *fermentation* (*see* Enzymes; Fermentation).

WATCHING THE YEAST PLANTS MULTIPLY



Yeast plants multiply by budding or "gemmation." You can see some of the tiny buds forming in this highly magnified picture. As the cells bud and grow, they form branching clusters, which later break up.

The kind of fermentation that is brought about by the "breathing" of yeast plants produces, among other things, alcohol and the gas called carbon dioxide. These are of no use to the yeast plants; they are merely by-products in getting oxygen. But from the human point of view they are of great importance. We use yeasts in the manufacture of wine, beer, liquors, and most of the raw alcohol employed in science and industry (*see* Alcohol). We use them also in breadmaking. Here, the carbon dioxide is the important factor. The yeast plants are buried inside the dough and immediately begin to work on the sugars contained in the flour. The bubbles of gas they give off as they breathe raise, or *leaven,* the dough, making the little round holes we see in bread after it is baked. The alcohol produced in the dough evaporates. (*See* Bread and Baking.)

How the Yeast Cells Grow

Under favorable conditions yeast plants grow and multiply with tremendous speed. As soon as a cell reaches full size, it immediately puts out a bud When this reaches full size, it puts out another bud, and so on, forming branching clusters which break apart from time to time and start new clusters.

When a yeast plant finds conditions unfavorable for its growth, it forms four spores within its cell, and shrivels up. The cell wall breaks, and the spores, like tiny particles of dust, are carried here and there by the wind or on the bodies of insects and other animals.

If we leave any moist substance containing sugar or starch open to the air, yeast spores are almost sure to fall into it and start fermentation. But certain kinds of yeast may create, along with alcohol and carbon dioxide, other substances with unpleasant flavors and odors. For this and other reasons, bakers, brewers, and wine makers do not rely upon the wild yeasts. A half-dozen of the most desirable species have been obtained in pure standard cultures and are regularly grown for use in the fermentation industries.

How We Get Our Yeasts

Various processes are used in the growing and manufacture of yeast, but all are based on the same principles. The tiny yeast cells must be provided with proper nourishment and plenty of air, under carefully controlled temperature.

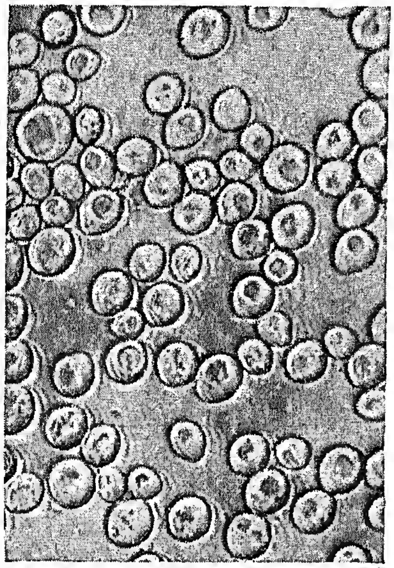
The proper foods for the yeast plants are corn, barley, malt, and rye. The grains are cleaned, ground in mills, and then "mashed," or mixed with filtered water. The corn must also be "cooked" before it is mixed with the other ground grains. Malt or sprouted barley is then added to the "mash," in order to convert the starch of the corn and rye into malt sugar, which is the food on which yeast plants thrive best.

The next step in the process is the addition of a pure culture of lactic acid bacteria. These are the bacteria which cause the souring of milk. They make the

grains still more digestible for the little yeast plants, and also insure a healthy fermentation. This action takes place in the "souring tank."

The mash is now ready to be filtered; the clear filtered extract is called the "wort." After being cooled, the wort is piped into huge copper tanks. Here living yeast plants from a former batch are added to start the growth of a pure culture, and the proper conditions for fermentation are supplied. The little yeast plants grow very rapidly, as they do later in the making of bread. At the end of about 12 hours, a great mass of yeast substance has been produced from the wort.

YEAST CELLS MAGNIFIED



These cells are magnified 1,000 times. You can understand how small the cells really are when you learn that a single cake of yeast, contains millions of them. If the cake is kept at the right temperature and moisture, the cells remain alive indefinitely.

The same yeast plants behave differently under different methods of fermentation. When fermentation takes place in a low temperature, the yeast forms soft masses at the bottom of the liquid and is called *bottom yeast*. In a high temperature the liquid bubbles vigorously and carries the yeast to the surface, forming *top yeast*. The squares that we know as compressed yeast are made by filtering out top yeast with a fine sieve and pressing it to squeeze out the water. Since the yeast plant is one of the chief makers of vitamin B, compressed yeast in the form of cakes or tablets is sometimes used as a food (*see* Vitamins).

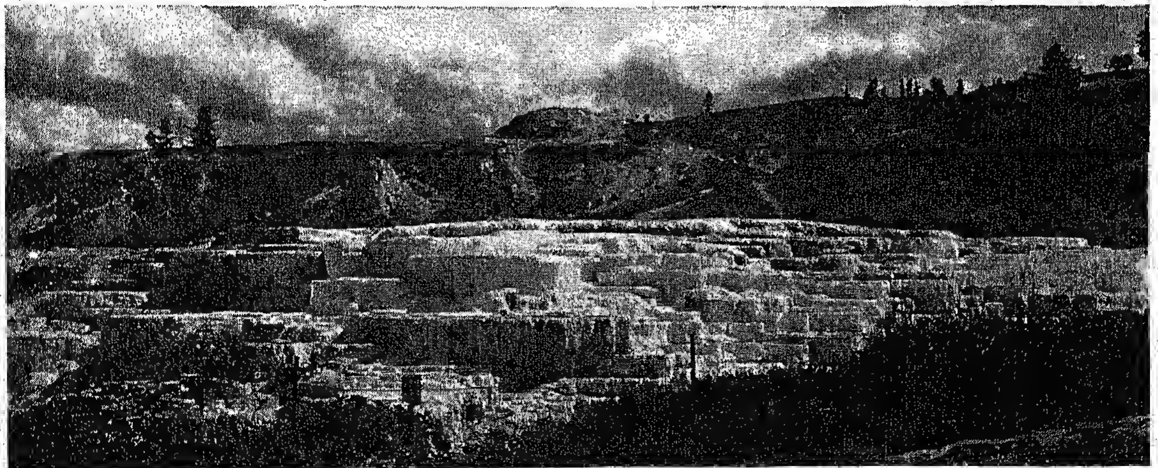
Yeasts belong to the order *Saccharomycetales*, of the class called sac fungi (*Ascomycetes*). The two important enzymes secreted by the yeasts of commerce are *invertase* and *zymase*. The first of these changes other sugars into *glucose* and *fructose*. These are then converted by the zymase into alcohol and carbon dioxide. (*See also* Fungi.)

YELLOWSTONE NATIONAL PARK. The oldest, the largest, and the most celebrated national park in the United States is the Yellowstone, in the heart of the Rocky Mountains. Its area of 3,471 square miles—more than two and a half times that of Rhode Island—lies mostly in northwestern Wyoming, but extends into Montana and Idaho. Probably no other region of similar size offers more varied or more colorful scenes.

The central portion of the park is a high, rugged tableland, which reaches an altitude of from 7,000 to 8,000 feet. Lofty mountains, rising to 10,000 and 11,000 feet above sea level, surround the plateau on the north, northwest, south, and east. The Continental Divide crosses the southwest corner of the park. Almost the entire region is volcanic, and both mountains and plain are formed from ash, lava, and other substances which have been ejected from deep down below the surface of the earth. Volcanic forces are still at work, as is shown by the numerous geysers and hot springs (*see* Geyser).

For many years some of the geysers, notably Old Faithful, and similar phenomena were the only attractions accessible to tourists. New trails and roads have been opened through the wilderness, however, and today visitors may enjoy deep cool forests and remote fishing grounds, as well as the more spectacular features of the park. Except for the construction of highways, the great "forest primeval" remains undisturbed. The trees are chiefly evergreens, the most common being lodgepole pine, Douglas fir,

A RAINBOW IN STONE—HYMEN TERRACE IN YELLOWSTONE PARK



At Mammoth Hot Springs, in the north of the park, the lime-laden waters have built up terrace on terrace of marble-like rock, tinted with pink, red, blue, and yellow by the algae found in the water. Nowhere else in the world are such formations known to exist.

and spruce. Foaming trout streams tumble into clear mountain lakes which mirror the snow-clad peaks. Flowing from Yellowstone Lake, one of the most beautiful mountain lakes in the world, Yellowstone River plunges over a precipice twice as high as Niagara into a marvelous multi-colored canyon. Here too Nature displays her curiosities to amuse the visitors. There are more geysers in the park than in any other geyser region of the world, and it is noted also for its petrified trees, for its boiling lakes and hissing hot springs and the scalloped terraces down which their waters pour; for its bubbling caldrons of many-colored clays. In its wildernesses, protected from hunters, roam deer, bison, antelope, bear, and other wild creatures.

One of the most famous sights is the great white cone, several hundred feet high, of the Mammoth Hot Springs. This consists of terraces of beautifully scalloped basins, streaked with bright red and yellow caused by the algae that live in the water. The water issues at the summit at nearly boiling temperature and gradually cools as it flows to lower levels.

The Yellowstone region was set aside as a national park in 1872. It now has many large hotels, lodges, and public camps and several hundred miles of roads. There are entrances on all four sides, three of which have railroad connections; and there is airplane service to West Yellowstone Airport, with bus service through the park. The National Park Service, through a superintendent and a force of park rangers, administers and protects this vast wonderland.

YEW. In the days of Robin Hood, before gunpowder had taken the place of bows and arrows, the strong and elastic wood of the yew tree was in great demand in England for the making of bows. Probably this is one of the reasons that explains why yews are found in nearly every churchyard in England. They were planted to insure a good supply of staves for making bows, as well as to protect the churches from high winds with their sturdy growth. It also became customary to clip the yew trees into smooth compact cones or pyramids of green, or into complicated geometrical shapes, and even into the semblance of grotesque beasts and birds.

The yew is a very slow-growing tree requiring a century or more before it is large enough for cutting. It is also a very long-lived tree. Some of the oldest specimens in England are over 10 feet in diameter and estimated to be over 1,200 years old. Yew wood is highly valued for cabinetmaking, because of its close grain, its reddish color, and its hardness. It takes a smooth and beautiful polish.

THE COMMON ENGLISH YEW

See how heavily this Yew branch is laden with its bright scarlet fruits. The foliage of the Yew is poisonous, especially to horses and cattle, but the leaves were formerly used as a medicine for human beings.

Yews belong to the genus *Taxus* of the yew family (*Taxaceae*). They are usually small trees or shrubs and are found throughout the Northern Hemisphere. The English yew (*Taxus baccata*) is cultivated in North America as far north as New York. The trunk is short and thick, with bark that has deep fissures when the tree becomes old. It may grow 60 feet high. Fruits appear in the autumn and some varieties have yellowish leaves.

The ground hemlock (*Taxus canadensis*) is a straggling low-growing shrub found as far north as Newfoundland. The Pacific or western yew (*Taxus brevifolia*) grows from 10 to 70 feet high and is found from Alaska to California. It is one of the important forest trees of the United States. The Chinese and Japanese yews will grow to 50 feet, but in North America they are commonly grown as small ornamental trees.

All yews have a naked seed surrounded by a fleshy cup, which gives the appearance of an open berry. The leaves are flat, ½ to 1¾ inches long, pale or yellowish on the underside, and poisonous to live stock. The small and solitary flowers appear in early spring.

YOKOHA'MA, JAPAN. The first thing the traveler notices, as his ship sails into the wide exposed harbor of Yokohama, one of Japan's chief seaports, is a long stretch of stone breakwater, within which lies a haven of perfect safety. This is a lasting monument to the friendly relations between Japan and America in the early period of their intercourse. In 1863 the feudal lord of Choshiu fired upon an American steamer passing through the straits of Shimonoseki in southwestern Japan and this hostile act resulted in Japan's paying the United States an indemnity of $800,000. A few years later the money was returned, and Japan, wishing to expend it in some way that would perpetuate in visible form the good will of America, decided to use it for the improvement of this harbor.

When Commodore Perry anchored off the coast of Japan, in 1853, Yokohama was an insignificant fishing village. In 1859 the Japanese government opened it as a treaty port and merchants of all nationalities, eager for trade, settled there in large numbers.

Thenceforward the city grew rapidly. It was connected with Tokyo, 18 miles north, by the first railroad in Japan (1872), and many fine buildings were constructed both in the town itself and in the foreign residential settlement on the "Bluff," a well-wooded hill commanding a beautiful view of the bay. These were nearly all destroyed by the great earthquake and fire of 1923, which left all but a fringe of the city in ruins and killed many thousands of the inhabitants.

Through Yokohama passes the bulk of Japan's trade with the United States. By far the most valuable item in this trade is raw silk, which is brought here by rail from the many silk-producing regions inland. Leading imports are raw cotton, oil, metals, machinery, wood, and wood pulp. The city is a great shipbuilding center. Other manufactures are bicycles and automobiles, electrical equipment, cereals, flour, and petroleum products.

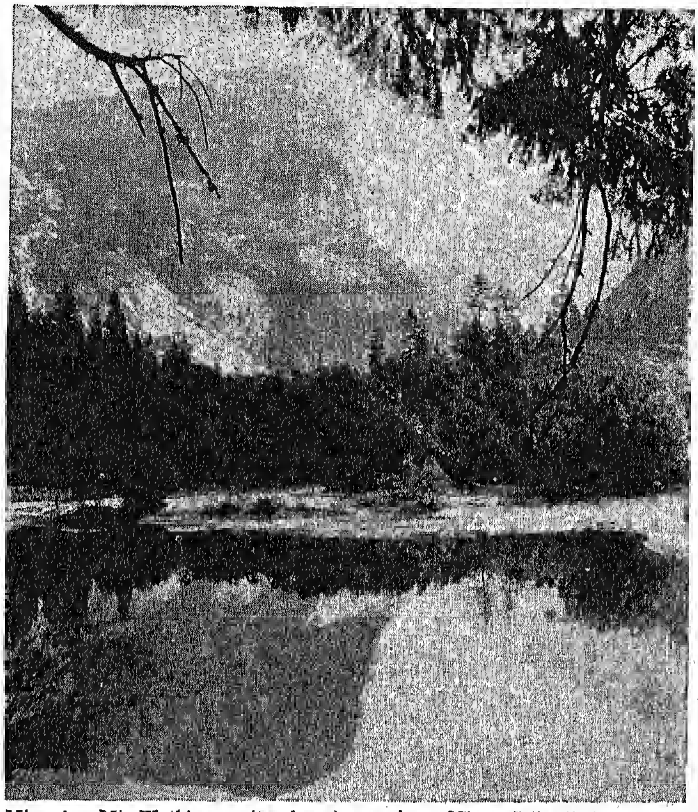
A considerable element of the population is Chinese, French, German, British, and American. With ships and merchant vessels flying the flags of every nation in her harbor, and tourists and sailors from all parts of the world along the "bund" (waterfront) in the bazaars and theaters, Yokohama easily supports its claim to being the most cosmopolitan city of Japan. Population, about 970,000.

YORKTOWN, VA. Yorktown, the county seat of York County, Va., has twice figured prominently in American history —in 1781 and in 1862. The little hamlet, situated on an arm of Chesapeake Bay, was the scene of the surrender of the British general, Lord Cornwallis, in 1781 —a surrender which virtually closed the Revolutionary War. It was again besieged in 1862 by General McClellan, the Union commander. The village is now part of the Colonial National Historical Park, which also includes nearby Jamestown and Williamsburg. The old fortifications, several 17th-century homes, and the oldest customhouse in the United States have been preserved. A monument recalls the surrender of Cornwallis.

YOSEMITE (*yō-sĕm'ĭ-tē*) **VALLEY.** So full of wild and varied beauty is this famous valley in central California that it has been made part of the Yosemite National Park to preserve a loveliness which travelers declare to be unequaled in all the world (*see* National Parks). It is 150 miles east from San Francisco, nearly eight miles long and a mile wide, "a mountain street full of life and light, graded and sculptured by the ancient glaciers . . . all enlivened and made glorious with rejoicing streams that come chanting in chorus over the cliffs and through side canyons in falls of every conceivable form, to join the river that flows in tranquil, shining beauty down the middle," to quote John Muir, the great naturalist and first apostle of the Yosemite. He calls the valley "a new song, a place of beginnings abounding in first lessons of life, mountain-building, eternal, invincible, unbreakable order."

The Yosemite Valley is a splendid example of glacial erosion on a grand scale. Five glaciers here united to carve this vast canyon out of solid granite. The valley was at one time a great lake basin, but the process of erosion silted up the lakes until now the valley floor is meadow land. Beautiful Mirror Lake is undergoing the same change, and in the past few years is said to have been reduced nearly one-half in area. Sand and silt from Tonaya Creek and Snow Creek may soon fill it full.

LOOKING ACROSS CHARMING MIRROR LAKE



Mirroring Mt. Watkins on its gleaming surface, Mirror Lake lives up to its name and its reputation for beauty. It is sad to think that the famous lake may soon disappear, filled up by silt which comes down from the mountains.

Near the upper end of the valley the Merced River plunges from a height of 594 feet, forming the famous Nevada Falls. The gauzy floating Bridal Veil Falls is 620 feet high. Yosemite Creek in a sheer drop of 1,430 feet forms the magnificent Yosemite Falls, and with a turn and sally cascades over another escarpment 320 feet high, forming the Lower Yosemite. Besides these there are the Narrow Ribbon, the Vernal, the Illilouette, and many smaller falls and cascades. Between the poised rock walls of the canyons run meadows of plumy ferns, starred with lilies, tuneful with

humming-birds and bees, the home of frail and transient beauty as the stern peaks are the thrones of majesty and endurance.

In Yosemite National Park are three groves of colossal sequoias, the Mariposa, the Tuolumne, and the Merced. Among the trees in the Mariposa Grove is the Grizzly Giant, thought to be at least 3,800 years old (*see* Sequoia). The park also has a large tract of the fast-dwindling giant sugar pine, a rare tree found only in California and Oregon. Within the park too is the beautiful Hetch Hetchy Valley, which lies along the Tuolumne River about 40 miles from Yosemite Valley. It has been converted into a great reservoir for San Francisco's water supply.

YOUNG MEN'S CHRISTIAN ASSOCIATION. The Y.M.C.A. is the creation of a young Englishman, George Williams (1821–1905), who went from the country to work as a clerk in a London dry-goods house. Williams became an unusually successful merchant in the great city; but his name is remembered and honored because of his interest in his fellow workers. He wanted to improve the environment of young men, to give them broader opportunities, and to transform character through the Christian life. He began by inviting a little group to meet with him for prayer and Bible study. Later he thought of forming a club, and his roommate suggested that he call it the "Young Men's Christian Association."

So, on June 6, 1844, 12 young men in London organized a club for the "improvement of the spiritual condition of young men in the drapery and other trades." Thus our familiar Y.M.C.A. was born. Through the influence and money which he gained later in life, Williams helped to spread associations through England and to several countries on the Continent. In 1894 he was knighted for his work by Queen Victoria.

In 1851 the movement reached North America, where the first associations were established in Boston and Montreal. Gradually it became world-wide. Today there are associations in more than 50 countries and the membership is not far short of two millions. Members are drawn from all races, and Y.M.C.A. buildings vary from thatched huts to skyscrapers. But the fundamental objective has remained the same, "to unite men and boys by a common loyalty to Jesus Christ for the purpose of developing Christian personality and building a Christian society." More specifically, the stated purpose of the Y.M.C.A. today is to help young people, through its programs and activities, to maintain health; to understand themselves and to make the right life choices; to gain skill in personal relations, in Christian leadership, and in coöperation; to learn how to use their leisure; and to develop a satisfying Christian philosophy of life.

Organization and Activities

The movement has had its greatest development in North America, where it now has more than a million members. There are associations in rural districts as well as in cities, and among special groups, such as railway employees, college students, the Army, the Navy, Indians, and Negroes. High-school students receive its benefits through Hi-Y clubs for boys or Tri-Hi-Y clubs for girls. There are also Gra-Y clubs for grammar school boys.

Y.M.C.A. associations engage in a great variety of activities and offer their members many advantages in such fields as education, religion, health, and recreation. They provide living quarters for young men in their hotels, as well as reading and social rooms, gymnasiums, and game rooms. They operate cafeterias and employment bureaus, and many of them conduct summer camps for vacationists.

Associations in the larger cities carry on extensive educational programs and offer vocational guidance. In addition to lectures and forums they offer high-school work and college courses leading to degrees in the arts, sciences, commerce, and engineering. Other activities include religious meetings, dramatic and musical programs, trips, social events, athletic contests, and other hobbies and special interests. During the World War of 1914–1918 the organization operated canteens and provided entertainment for soldiers. As a member of the United Service Organizations, formed in 1941, the Y.M.C.A. operated service clubs near military, naval, and defense establishments.

Each community organizes its own Y.M.C.A. and plans its activities, and each unit determines for itself who may become a member. In general, any young man of good moral character is eligible, although some units require membership in an evangelical church. Some associations admit women to membership. Local volunteer workers interested in the welfare of youth act as leaders of groups or as directors and committeemen. The activities are under the executive direction of professionally trained leaders. A national association serves as a clearing house for the local units and renders various services to them. National associations are united in the World's Alliance, which has headquarters in Geneva, Switzerland.

YOUNGSTOWN, OHIO. A visitor to Youngstown hears talk of steel on all sides, for the livelihood of virtually everyone there rests upon steel. The city, on the Mahoning River in northeastern Ohio, is the heart of the third largest steel district in the United States. The flaring glow of steel mills and blast furnaces lights the valley for 25 miles, and the works extend into the adjacent Shenango and Beaver valleys of Pennsylvania.

Although the city's first steel plant was not built until 1892, Youngstown has been an iron-working center almost from its beginning. It was founded in 1797 by John Young of Whitestown, N. Y. Just five years later, the first smelter was set up to produce iron from local ore, limestone, and coke. Even when failing local supplies later forced Youngstown to turn to Lake Superior ore and Pennsylvania coal, the city held its high rank. A chief reason was the excellent transportation system which had grown up around it. Four major railroads serve the city and are now supplemented by fleets of trucks.

Steel is the basis of most of the city's other manufactures as well. Among the principal products are wire, boilers, tanks, metal sheet and tubing, radio towers, cranes, bridges, fireproof furniture, and material for building construction. From the coke-ovens of the mills come important by-products, such as tar, benzol, toluol, and naphthas. Other manufactures are rubber goods and electric light bulbs. Quarries in the rolling hills around supply lime for making cement and brick.

In recent years Youngstown has been attacking the social and cultural problems of a heavily industrialized city. It is working to assimilate its foreign element, which came to work in the mills and now forms about half the population. It is improving recreational facilities and extending the park system, which includes scenic Mill Creek Park. Among the educational centers is Youngstown College. Butler Art Institute has notable works by Sargent, Inness, Winslow Homer, Gilbert Stuart, and E. A. Abbey. Population (1940 census), 167,720.

YOUNG WOMEN'S CHRISTIAN ASSOCIATION. One of the best known and loved of modern emblems is the Blue Triangle of the Y.W.C.A. It is found in every large city of the nation and in hundreds of smaller communities. It signals a welcome to girls in many foreign cities. It stands for the Association's aim "to advance the physical, social, intellectual, moral, and spiritual interests of young women."

As an example of one of the many services offered by the "Y.W.," let's take the case of Mary Jones, who comes from a small town or farm to work in the city. At the railway station, a Travelers' Aid staff worker suggests that she go to the Y.W.C.A. There a pleasant young woman greets her, answers her questions, and directs her to the tea room for a moderately priced meal. Mary may find a room in a "Y" residence, or in a private home that has been approved by the room registry. She is invited back to the Association's headquarters, where the welcome is so cordial that she soon loses her sense of strangeness and begins to take part in the activities of the organization.

A Place for Study and Recreation

But taking care of strangers is only one part of all that the Blue Triangle stands for. Thousands of girls stop school to earn their living. The "Y" offers them evening classes, where they may overcome educational handicaps or cultivate stimulating new interests. There are practical courses that teach typing and shorthand, English and speech, cooking, sewing, and millinery. There are classes also in cultural or social arts, such as dramatics, psychology, music appreciation, Spanish, and contract bridge. Discussion groups encourage girls to think and talk about their personal problems or world affairs. There are Bible classes and Sunday vesper services. Vocational counselors test a girl's qualifications and advise her on job requirements and opportunities. An employment bureau helps to place her in a position.

Blue Triangle secretaries know that many young women need a chance for exercise and recreation in the evening, so Association quarters usually include a large airy gymnasium and a swimming pool. There are physical fitness and reducing classes; dancing and swimming lessons; sports, such as archery, badminton, volley ball, and bowling. Parties and dances provide good times for the girls and their friends. Y.W.C.A. summer camps supply vacation sports and relaxation at reasonable cost.

Clubs are formed within the Association to foster special interests of various groups—business and professional women, factory workers, or student nurses. The industrial department may take over "Y" quarters for an "owl" party from midnight to dawn, where late shift workers can find wholesome gaiety.

At colleges and universities, student Y.W.C.A.'s offer Christian fellowship and counsel to girls "on their own" for the first time and seeking answers to perplexing questions of conduct and faith.

Girl Reserves Develop Leadership

The Girl Reserves, the junior members of the Association, carry on activities designed to help with the problems of "growing up." Girls from 12 to 18 develop leadership by planning club programs, conducting meetings, and engaging in community service. Camps and sports offer healthful fun.

The Y.W.C.A. is a member of the Council of Social Agencies in most cities and shares in community funds. It supports worth-while social and economic movements, such as world peace and better interracial relations. As a member of the United Service Organizations, it operated service clubs near military, naval, and defense establishments in the second World War. In the first World War, its "Hostess Houses" served the troops.

The Y.W.C.A. movement started in England in 1855 when Miss Emma Robarts formed the English Prayer Union, and Mrs. Arthur Kinnard established a home for nurses returning from the Crimean War. A forerunner in the United States was the Ladies' Christian Organization of New York City, organized in 1858. The Young Women's Christian Association of Boston was established in 1866. Similar organizations sprang up over the country, and a National Association was formed in 1906. As the movement spread over the world, organizers from the United States helped to train the members to lead their own organizations and to become self-sustaining. By 1940 there were associations in 52 countries, banded together in the World's Council. Some 2,800,000 girls and women participate in the Y.W.C.A. program in the United States.

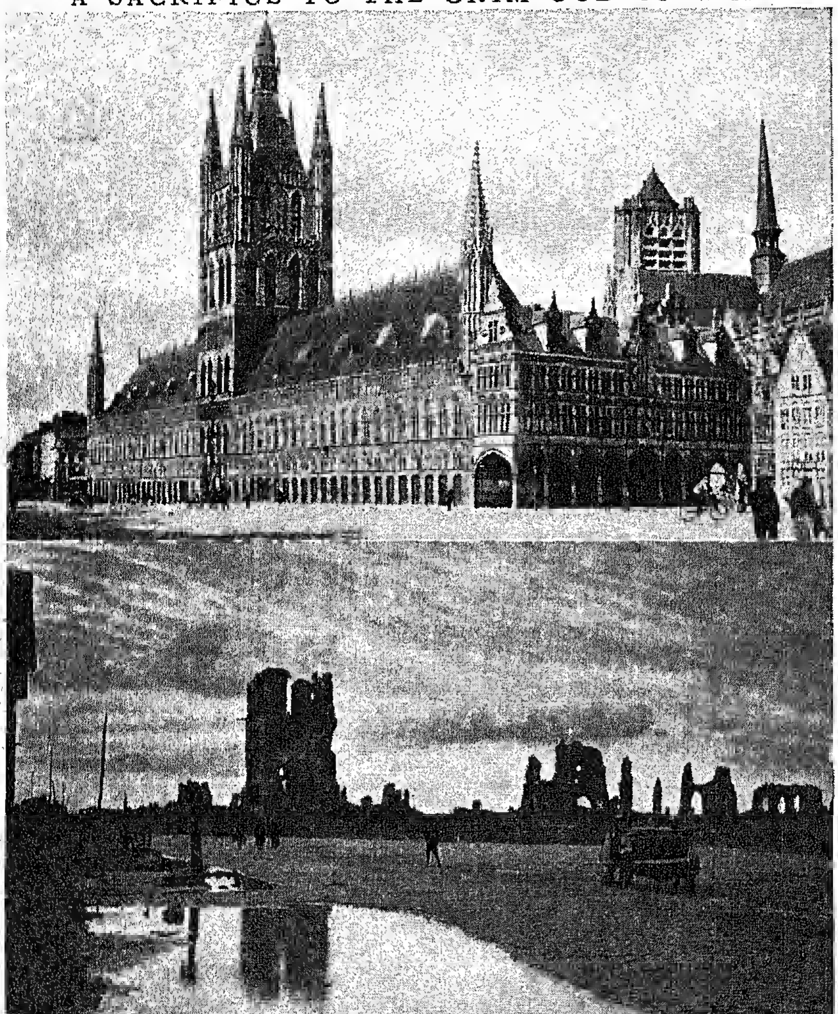
YPRES (*ē'pr'*), BELGIUM. No name connected with the World War of 1914–18 will live longer in men's minds than that of Ypres—the "Wipers" of the British Tommies—a famous old city in West Flanders, 35 miles south of Ostend.

In the 13th century Ypres was one of the most important cities in western Europe and the center of the manufacture of woolen cloth. With the decline

of that industry and the passing of time, it became a quiet little town, whose chief occupation was the leisurely manufacture of handmade lace. There remained, however, the beautiful Cloth Hall, one of the finest specimens of Gothic municipal architecture in Europe; the old Gothic Butcher's Hall, with its museum of antiquities and paintings; the wonderful medieval cathedral of St. Martin; and many other works of art, the pride of the burghers and a testimonial of the city's former glory. Then the World War of 1914–18 swept away all its treasures. A battered "City of the Dead" huddled in the ruins, and a huge graveyard spread over the countryside.

Ypres was never held by the Germans, but it was bombarded continuously by them throughout the war. The battle of Flanders began with an attack on the city in October 1914. Just south of it was fought the furious battle of St. Eloi in March 1915. The resulting salient was straightened by the Allies in 1917; but the next year the Germans threatened Ypres again. After the war the city was largely rebuilt. The Cathedral and the Cloth Hall were reconstructed, using the original stones wherever possible. The Menin Gate is a memorial to the thousands of British soldiers who died here. Population, about 17,000.

A SACRIFICE TO THE GRIM GOD OF WAR



Above we see the beautiful Cloth Hall at Ypres as it looked before the first World War. The picture below shows what was left of it at the end of that war, after years of battering by German guns. It has since been rebuilt, largely from the original stones, but the handiwork of the medieval builders is gone forever.

YUCATAN (*yo̤-kä-tän'*). This tropical peninsula of Central America reaches northward toward Cuba, dividing the Gulf of Mexico from the Caribbean Sea. It includes British Honduras, the northern third of Guatemala, the Mexican states of Yucatan and Campeche, and the Mexican territory of Quintana Roo.

It consists of a low tableland, about 400 miles long by 200 miles wide, broken by hills and ridges. The underlying rock is a porous limestone into which rain water quickly disappears. There are few running streams, but undersurface water is plentiful.

The northern part of the peninsula is covered with stunted trees and shrubs and patches of open grassland. To the southeast, as rainfall increases, the country becomes a tropical jungle. Most of the half-million people, chiefly of Mayan Indian stock, live in the north.

Mexican Yucatan is the source of most of the world's supply of henequen, from which binder twine is made. The privately owned plantations have been expropriated by the government and turned into collective farms. From southeastern Yucatan comes most of the world's chicle, the basis of chewing gum.

Mérida is the chief city (population, 120,000), the center of the henequen industry. Its seaport is Progreso (population, 15,000), with which it is joined by rail and highway. Campeche (population, 20,000) is the chicle center. Buried in the jungle are the ruins of cities that flourished before the coming of the Spaniards, built by the ancestors of the present Maya Indians (*see* American Archeology). The Mayans

were at first merely tillers of the soil, but the fertility of the area richly rewarded their daring conquest of nature by leisure and other favorable living conditions, out of which suddenly sprang the amazingly advanced Mayan culture. The cities were the religious and governmental centers; the mass of the people lived in thatched houses near their fields.

The Maya territory extended over Yucatan, the south Mexican states of Tabasco and Chiapas, Guatemala, British Honduras, Honduras, and a portion of Salvador. The first great cities flourished in Guatemala and Honduras from about 300 to 600 A.D., the period of highest attainment of Mayan culture. Then suddenly their inhabitants moved toward Yucatan. We are not certain why these cities were deserted.

Climax of Indian Civilization

For 300 years after the move into Yucatan no great developments seem to have taken place. Then about 1000 A.D. three cities—Chichen-Itza, Uxmal, and Mayapan—formed a league, and they soon dominated the peninsula. Under their rule, the civilization of the American Indian reached its climax.

Internal strife wrecked the confederacy. Civil war broke out, and Mayapan sought the aid of the Toltec of Mexico against her former allies. The northern armies were successful, and won Chichen-Itza.

After a brief period of advance, war broke out again. This time Mayapan fell. The country was torn by many warring factions. Agriculture was neglected and famine and pestilence followed.

This was the condition when the Spaniards arrived. The golden days of the Maya had passed. For 14 years they struggled against the European invaders and were finally defeated. The Spaniards looted their temples, destroyed their sacred writings, and crushed their rulers. Their cities were abandoned, and during four centuries the jungle reconquered the land and buried the cities. Today archeologists are recovering the story of this lost civilization.

The principal structures in the cities were generally arranged around courts or plazas, and stood on terraces or pyramids. Always there was a pyramid topped with a temple. Elaborate buildings of many rooms appear to have been the houses of the rulers. Round towers were used as astronomical observatories.

Mayan Building Methods

In a number of buildings the Mayans used the false arch. These were built by placing great stones horizontally until they met at the crown, or top. Strong supporting masonry was necessary, and so the walls were thick and the rooms narrow.

The walls and the pyramids on which the buildings stand were usually constructed of rubble and cement, faced with cut stone. At the sides and tops of doors and along the upper portions of the buildings were elaborate carvings in low relief. Decorations were mostly geometric, but serpents, grotesque human faces, and other figures were common. Carvings of snakes often paralleled the steps leading to the tops of the pyramids; and in terraces and plazas were stone columns, representing priests and warriors, with dates and hieroglyphic writings.

These people worked out an exact mathematical system based on zero; they carried astronomical observations so far that they developed an accurate calendar. Their hieroglyphic system of writing closely approached an alphabet. They had books written on deerskin or paper made of hemp fiber sized with lime. Painted manuscripts dealt with the calendar and religious ceremonies. The magnificent buildings are proof of their great skill in architecture; and ball courts tell us they enjoyed sports. The more intimate story of their life is seen in wall paintings, in objects placed with the dead, and in offerings thrown into sacred wells. These give evidences of a people far developed in minor arts, such as weaving, pottery, and metal work.

Gold and other metals, imported from a distance, were used as ornaments. It is a remarkable fact that this, the greatest of American Indian cultures, developed without the aid of domestic animals, and with very little metal.

Yucca. Few plants native to the warmer portions of North and Central America find a wider variety of uses than the yucca, a plant of the lily family. One striking species adorns many gardens in the southern part of the United States; others supply fibers with which the natives of Mexico and Central America make ropes. The fruit of one is like a small banana and is eaten in Mexico and Central America. The roots contain a substance used as soap.

The common bear-grass (*Yucca filamentosa*) of the southern states forms near the surface of the ground a rosette of soft weak leaves fringed with fraying fiber, from which shoots up a splendid spike of creamy drooping bell-shaped blossoms. The "Spanish bayonet" (*Yucca gloriosa*), another species of the southern states, has a single woody stalk, which grows as tall as a man or taller, bristling in its upper portion with terrible stiff dagger-like leaves. Other species found in Mexico and the Southwest are treelike.

The manner in which the yucca is fertilized is one of the wonders of plant life. The anthers of the large white blossoms reach nowhere near the stigma, and the plant depends for its survival on certain little white moths. During the day the yucca moths, either singly or in pairs, rest with folded wings within the half-closed flowers. After dark, however, the female sets to work scraping pollen from the anthers, and when she has secured enough, shapes it into a pellet two or three times the size of her head. Flitting to another flower, she lays an egg in the soft tissue of its pistil, and thrusts the pollen ball into the stigmatic funnel, ramming it down with her head. She thus pollinates the plant, so that seeds may be formed to furnish food for the larva when it hatches.

There are about 30 species of the yucca, which is a genus of the family *Liliaceae*. Its flowers are numerous, usually white in color, bell-shaped, and pendulous. From the flower there develops a succulent berry in some of the species and a dry three-valved capsule in some of the others.

The TROUBLED STORY *of the New* SOUTH SLAV STATE

Extent.—North to south, about 330 miles; east to west, greatest distance, about 370 miles. Area, about 96,000 square miles. Population, about 15,000,000.
Natural Features.—Rivers: Danube, Sava, Drava, Morava, and Vardar. Mountains: Dinaric and Julian Alps, Karst Plateau, and Shar. Climate: continental in interior with typical Mediterranean mildness on Dalmatian coast.
Products.—Corn, wheat, barley, oats, rye, potatoes, grapes, sugar beets, hemp, flax, tobacco, plums, apples, pears; horses, mules, asses, cattle, sheep, hogs, and goats; silk; timber, coal (chiefly lignite), iron ore, bauxite, copper, gold, lead, chrome, antimony, and cement; flour, cotton goods, carpets, boots, iron and steel.
Cities.—Belgrade (Beograd) (capital, population more than 240,000); Zagreb (Agram), Subotica (Maria Theresiopel) (more than 100,000); Sarajevo, Skoplje (Üsküb), Novi Sad (Neusatz), and Ljubljana (Laibach) (more than 50,000).

YUGOSLAVIA. When diplomats had redrawn the frontiers of Europe after the World War of 1914–1918, certain new names appeared on the map. One was Yugoslavia, from words meaning "south" and "Slavs." This nation was formed out of the former kingdoms of Serbia and Montenegro and parts of the former Austro-Hungarian Empire, including Bosnia and Herzegovina, most of Dalmatia, Croatia-Slavonia, Slovenia, and the Voyvodina.

The formation of Yugoslavia was one of the most difficult problems of the peacemakers. Indeed, it was not until 1924, after prolonged conferences, that the Italian frontier was finally determined (*see* Fiume).

There was trouble within the new nation as well. Although the South Slavs had long worked for a united state, it soon became evident that the various elements—Serbs, Croats, and Slovenes—were to have difficulty in maintaining themselves as a united nation. They were related by blood, but they had lived under different masters and had developed widely different ideas and ways of living. The Croats and Slovenes, in the north, had the highest culture, acquired from Budapest and Vienna. Their customs were those of Western Europe; whereas those of the Serbs, in the southeast, were semi-Oriental. They were Roman Catholics; the Serbs were Greek Orthodox. They used the Latin alphabet. The Serbs used the Cyrillic, like their kinsmen, the Russians.

A SLOVENE WOMAN

The costume of the country people of Yugoslavia is picturesque as well as serviceable. This farmer's wife, however, is in her much prized Sunday best, with silk apron and shawl.

The Serbs Win Precarious Power

Croatia-Slavonia was somewhat industrialized, but the rest of Yugoslavia was almost solely agricultural, and largely undeveloped. The Serbs had been kept down through years of domination by Turkey. The Croats and Slovenes felt superior to the Serbs, but Serbia nevertheless was the dominant element in the new state from the beginning. More than a third of the total population were Serbs. Serbia had a well-organized national administration at Belgrade, and, with the exception of Montenegro, was the only part of the new state with any experience in complete self-government. Besides, Belgrade was situated in a key position at the crossing of great highways, and was the logical capital of the new kingdom. In the closing months of 1918, Prince Regent Alexander of Serbia was invited to take the throne of a united Yugoslavia.

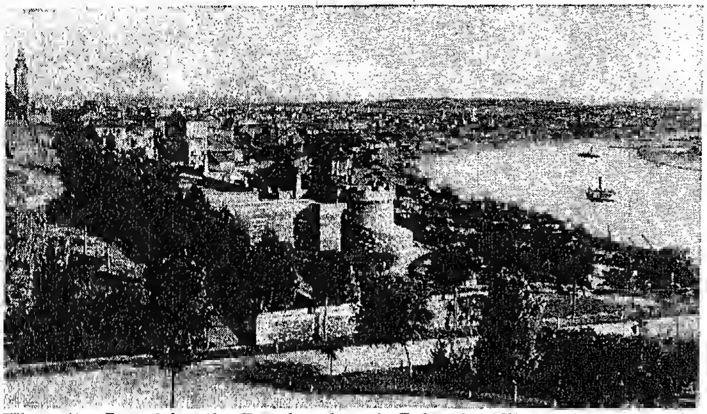
The political situation, chaotic at first, gradually became a struggle between the Serbs, favoring a strong central government dominated by Belgrade, and the Croats and Slovenes, who wanted a decentralized state. The Serbs were victorious. In June 1921, a constitution was adopted creating a strongly centralized Serb state. The Croat peasants did not vote. In the years that followed, friction between Serbs and Croats increased and reached a climax on June 20, 1928, when a radical deputy shot at the Croatian deputies on the floor of parliament, killing two and fatally wounding the outstanding Croat leader, Stephan Raditch. The Croats withdrew from Belgrade entirely, and the break-up of the kingdom seemed likely when King Alexander, on Jan. 6, 1929, suspended the constitution and made himself dictator. Two years later parliamentary government was nominally restored, under a new constitution, but the king dominated the parliament and continued to rule autocratically. A rigid censorship was clamped on, and every effort was made to prevent a show of dissatisfaction. Alexander was assassinated Oct. 9, 1934, and was succeeded by his 11-year-old son Peter, under a regency.

Finally, after 20 years of bitter struggle, the problem of maintaining national existence in the midst of a European war forced the Serbs in August 1939 to yield to Croat demands. An autonomous Croatia was set up, self-governing in everything but communications, national defense, and foreign affairs.

Friendships and Rivalries

In foreign affairs, Yugoslavia naturally aligned itself with the other Balkan States that wanted to preserve the boundaries laid down in 1919. It formed the Little Entente with Czechoslovakia and Rumania in 1920–22, and the Balkan Entente with Greece, Turkey, and Rumania in 1934. But by 1941 German conquests and alliances had virtually encircled Yugoslavia. So its government, submitting to German pressure, on March 25 joined the fascist "new order" alliance. Two days later this government and the regency were overthrown, and young King Peter II took the throne. On April 6 Germany invaded Yugoslavia and Greece. In 12 days of "lightning war" it routed the disorganized and isolated Yugoslav forces.

ONE OF BELGRADE'S RIVER HIGHWAYS



Where the Sava joins the Danube, there is Belgrade. The picture shows the improved port on the Sava, a trade center for river steamers from all over the Balkans. In the foreground are some of the city fortifications.

Hungary and Italy seized parts of Yugoslavia, and Croatia was made an "independent" kingdom. (*See also* World War, Second.)

People of the Kingdom and Its Resources

All the South Slavs are gay and pleasure-loving. They like to sit in coffeehouses, sipping countless cups of black Turkish coffee and talking by the hour. On Sundays and feast days they gather in the village squares and dance their spirited national dances to the music of gipsy bands. (*See* Slavs.)

The country has rich natural resources—a fertile soil, abundant mineral deposits, vast forests, and a great but undeveloped water power. Agriculture is the basic industry, with livestock raising ranking second, and forestry third. Corn and wheat are the principal crops and normally constitute the most valuable exports. Other grains, including barley, rye, and oats, are also raised. There are enormous plum orchards, especially in Serbia and Bosnia, where the favorite beverage is plum brandy (*slivovica*). Delicious plum jam is served at almost every meal, and prunes constitute a valuable item of export. Grapes are grown throughout the kingdom, and wines are exported. Beans and peas are valuable products; the leading industrial plants include sugar beets, hemp, hops, opium, tobacco, cotton, and flax. The cotton textile industry has become increasingly important. Silkworms are raised in the many mulberry trees of Serbia to help supply its silk textile industries.

More than 30 per cent of the kingdom is covered with forests, and timber is one of the chief exports. With the exception of chemicals and fertilizers, which are important exports, manufactures are chiefly for home consumption. The chief products are flour, meat products, boots and shoes, paper, cotton goods, carpets, pottery, and iron and steel.

Mineral Resources Being Developed

Minerals are numerous and abundant, but mining was long hampered by lack of capital. European rearmament impelled foreign companies to help develop mines, so that the country became a large exporter of mineral ores, chiefly copper, aluminum, manganese, iron, chrome, zinc, lead, and antimony. Its coal is of poor quality, chiefly lignite, and coking coal has to be imported.

There are many navigable rivers, of which the Danube and Sava are the most important, and there are fine natural harbors all along the ragged Dalmatian coast. The railroad system, comprising the separate lines of the old kingdoms, fails to tie together the points of present importance.

MOUNTAINS PLUNGE DOWN TO THE SEA

The Gulf of Kotor (Cattaro), shown here lined with picturesque hamlets, ranks among the world's best natural harbors. Like Yugoslavia's many other harbors along the Adriatic, it has comparatively little traffic because of poor communication with the interior. Stern limestone mountains with few passes—the Dinaric Alps, a southward extension of the main Alpine chain—wall off the Dalmatian coast from the rest of the country.

Belgrade, the capital, and Skoplje are the principal cities in the Serbian part of the kingdom. Zagreb, the second city, is the chief city of Croatia-Slavonia; and Ljubljana, of Slovenia. Subotica and Novi Sad are the chief cities of the Voyvodina district, formerly Hungary's. In Bosnia is Sarajevo, where an assassin fired the shot that started the World War of 1914–18. Area of Yugoslavia before German conquest, about 96,000 square miles; population, 15,000,000. (*See also* Balkan Peninsula; Belgrade; Bosnia and Herzegovina; Montenegro; Serbia; Slavs.)

YUKON (*yu'kŏn*) **RIVER.** Because there are almost no railroads in the rich mineral-bearing Yukon Territory and in east central Alaska, the Yukon River is the chief means of transportation for this vast region. It is the largest river of Alaska and the fifth largest in all North America. Few rivers are navigable for so large a proportion of their length. Except for a few miles of rapids, the river is open in summer to steamboat navigation for its entire length—close to 1,800 miles—from Lake Bennett to the Bering Sea. Small steamboats have descended the entire series of rapids, but on the up-journey the most extensive of these, the White Horse, is impassable. At this point a railway connects the navigable parts of the river.

The Yukon is remarkable in that it rises within 15 miles of the Pacific Ocean and finally, after flowing in a great arc, reaches the same ocean again on the west coast of Alaska. The river, which in its first few hundred miles is known as the Lewes, has its source in small streams of Chilkoot Pass in British Columbia. But its main forming basin is Lake Bennett (altitude 2,160 feet) on the southern boundary of Yukon Territory. Through this it flows north and northwest, and, after completing less than half its course, enters Alaska. Here it continues northwest to the Arctic Circle and then turns abruptly to flow southwest most of the remaining way to the sea. In most of its upper course it is shallow and narrow, expanding at intervals into lakes.

Where the Lewes joins the Pelly River, about 175 miles below the rapids, the Yukon proper begins. The Yukon has other large tributaries—the White, Stewart, Klondike, and Fortymile rivers in Canada; and the Porcupine, Tanana, and Koyukuk in Alaska.

The Vast Area Drained by the Yukon

The Yukon's drainage basin, which covers more than 330,000 square miles, is about the size of Texas and Oklahoma together. Most of this basin is mountainous and hilly, with wooded valleys. There are also flat marshlands. The largest of these, the Yukon Flats, flanking the river near the Arctic Circle, is more than 100 miles long and 40 to 100 miles wide. Here the river itself becomes from 10 to 20 miles wide.

In Yukon Territory the chief ports on the river are White Horse, on the Lewes, and Dawson, where the Yukon and Klondike rivers meet. Dawson is the port for the gold-mining Klondike region. In Alaska the chief river towns are Fort Yukon and Tanana.

YUKON TERRITORY, CANADA. Few people know this untamed region in the northwestern corner of Canada, except from stories about the men who sought its gold. With an area of 207,076 square miles, it is about one-third the size of Alaska, but a small town could hold all its people. It stretches north from British Columbia to the Arctic Ocean and west from the Northwest Territories to Alaska.

Most of the Yukon is mountainous. In the extreme southwest is the St. Elias Range containing Canada's highest mountains. These are Mount Logan (19,850 feet) and Mount St. Elias (18,008 feet), the latter on the Alaskan border. The Yukon River and its tributaries drain the central Yukon Plateau.

The climate is typically continental, with extremes of temperature from 95° F. in summer to −68° in winter. The winter average is 0° to −20°; the summer average, 50° to 58°. The mountains on the west cut off much rain and snow. Thus the precipitation for a whole year ranges between only 7 and 19 inches.

In summer the sun shines 20 hours a day, and such crops as potatoes, turnips, oats, rye, barley, and hay ripen in an astonishingly short time. Most of the food supply, however, must be imported. There are forests of spruce, birch, and poplar, but relatively few trees attain sawmill size. Caribou, moose, bears, and small fur animals abound.

Gold Rush, Government, and People

In 1897 and 1898 the Yukon was the scene of a wild gold rush set off by the finding of gold in Bonanza Creek, a tributary of the Klondike River (*see* Klondike). Where a few Indians had lived, thousands of prospectors now crowded in. Local government to keep order was lacking. So the Yukon, which as a part of the Northwest Territories had been governed from Ottawa, was made a separate territory in 1898. Dawson, center of its gold rush, was made the capital. A controller and an elected council of three members administer the government. The territory elects a representative to Canada's House of Commons.

The population, more than 27,000 in 1901, has declined to about 4,000. This is because the richest placer deposits are now exhausted and expensive hydraulic equipment and dredges are required to mine gold in profitable amounts. Silver and lead are mined around Mayo on the Stewart River. Coal and copper still await exploitation on a large scale.

Airplanes, Steamboats, and Sledges

The modern airport at White Horse, the second town in the Territory, is a link in the "northwest passage by air" to the Orient—the route that passes through Edmonton (Alberta), Fort Nelson (British Columbia), White Horse, and Fairbanks (Alaska). Many supplies are brought in by way of the White Pass and Yukon Railway, 111 miles long, from Skagway, Alaska, to White Horse. Passengers and freight are carried in summer to many points of the interior by stern-wheel steamers on the Yukon River and its tributaries. Travel in winter is largely by ski planes and dog sledges.

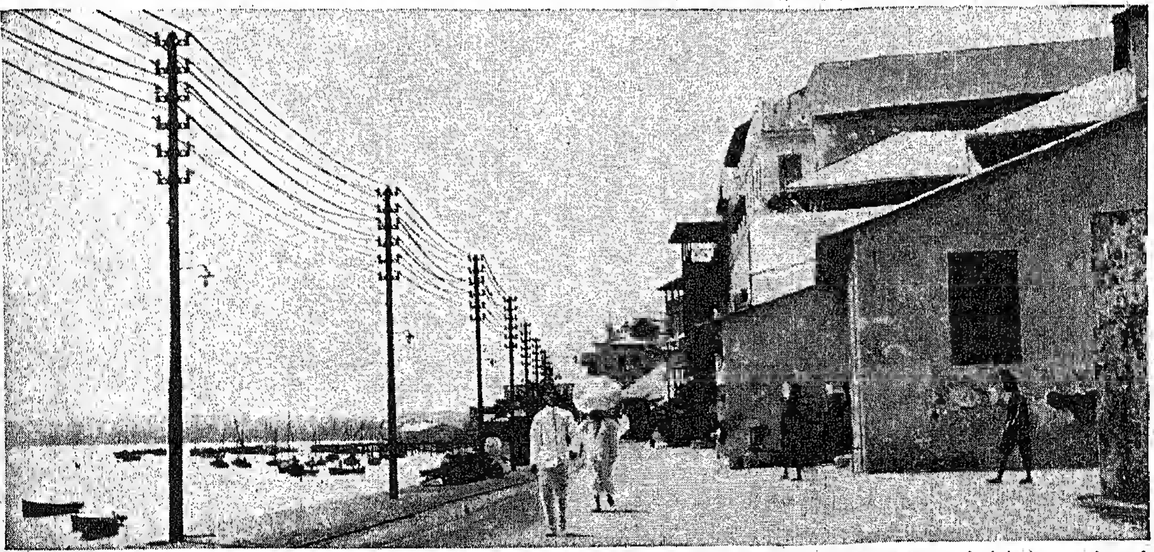
ZAMBEZI (*zăm-bē′zĭ*) **RIVER.** Although the lower region of the Zambezi, for at least 300 miles from its mouth, has nominally been in possession of the Portuguese since the beginning of the 16th century, it is only since the last half of the 19th century, through the reports of Livingstone and other explorers, that we have gained any definite knowledge of this vast region. We now know that the Zambezi is the fourth river in size in Africa, that it has a length of 2,200 miles, and that it rises in a black marshy bog in the northwestern part of what is now the British territory of Rhodesia, and flows south and east, discharging into the Indian Ocean. In its upper course the Zambezi flows through dense forests, alternating with an open bush country, with extensive stretches of flat country subject to widespread floods. At the eastward edge of the central plateau of Africa are located the Victoria Falls (*see* Victoria Falls), the greatest waterfall in the world. The Zambezi is navigable for stern-wheel steamers from the sea to beyond Tete, a distance of 400 miles; with the construction of locks here and there, more than 4,000 miles of navigable waters could be obtained.

ZAN′ZIBAR. "When you play on the flute at Zanzibar," says an Arab proverb, "all Africa as far as the lakes dances." This tiny speck of an island off the eastern coast, like the rivet in the handle of a fan, was long the point from which radiated Arab influence through a wide circle, from the land of the Somalis on the north to Africa's Niagara, the Victoria Falls of the Zambezi, on the south. All of that region was once, in a more or less haphazard way, the empire of the sultan of Muscat, who ruled from his capital on the coast of Arabia until his seat of government was transferred to Zanzibar in 1832. Thus the island naturally became a point of departure for European exploration, missionary labor, and commerce in the 19th century.

As you recline on a deck-chair in its busy harbor, with every kind of craft fussing back and forth, from French cargo-boats and British warships to Arab *dhows*, you sense something of the lure of the tropics, for Zanzibar lies only 6 degrees south of the Equator. Ashore white flat-roofed houses gleam in the noonday glare. The black spots you see are massive carved doors, heavy and lovely, shutting out the stifling heat and the outside world from cool interiors, to which Arab influence has brought splashing fountains and the seclusion of its womenkind. The bright vermilion patches are blossoming acacias which tower above high garden walls.

The streets are narrow and dirty, with Hindu money-lenders, Singhalese merchants, negro porters, fishermen, and half-castes cluttered together in amazing

ALONG THE WATERFRONT OF THE CITY OF ZANZIBAR



Although an important port, Zanzibar has no docks. Passengers from large steamers go ashore in rowboats, and freight is transferred in lighters or barges, some of which, with their masts tilted at every angle, may be seen near the shore. In the center is a native "laundry," carrying somebody's washing on her head. The city is on the channel which separates the island of Zanzibar from the African mainland.

confusion. One writer describes the city as "a cesspool of wickedness, oriental in its appearance, Mohammedan in its religion, Arabian in its morals, a fit capital for the Dark Continent."

But so long as great "tuskers" roam the impenetrable forests of the interior, romance will cling to Zanzibar's skirts, for it is the great ivory port of the world. Piles of mellow deep cream shining tusks lie along the docks, waiting for the steamship to carry them to England. Here, too, are heaps of pleasant-smelling copra, the dried meat of the coconut, bound for Marseilles, and less alluring hides and skins. Countless bales are crammed with dried cloves—the brown flower-bud of a tall evergreen tree whose pungently fragrant fruit, first green, then bright red, is so inextricably bound up with the development of trade in the East. The bulk of the world's supply of cloves, indeed, now comes from Zanzibar and its sister island Pemba, just to the north.

The two islands, which have been independent of Muscat since 1856, are ruled by an Arab sultan, but they have been under British protection since 1890. The chief island is 48 miles long by 15 broad and is separated from the African coast by a channel 22 miles wide. With Pemba the area of the Zanzibar Protectorate is a little more than 1,000 square miles. Both islands are highly cultivated, clove plantations being the most important. The population is about 245,000; that of the city of Zanzibar about 45,000.

ZEBRA. This curious striped animal of Africa is a member of the horse family and is closely related to the wild ass. The mountain zebra (*Equus zebra*) inhabits mountainous regions in Cape Colony. Owing to the pursuit of hunters, it is scarce now and is fast being exterminated. It is about four feet high at the shoulders. Its general color is white, with black stripes on the body, legs, and tail. Those on the legs extend to the hoofs and those on the tail to the tuft of hair.

THE STRIPED WILD HORSE OF AFRICA

Transvaal Zebras roam the South African veld. While the mare and the foal in this museum group are resting, the stallion is impatiently pawing the earth as if aware that a striped suit affords no protection in the open, though in the shadows of the brush it is an effective camouflage.

Burchell's zebra, found in the plains of South Africa, is a larger and more robust animal, with a longer mane and a fuller tail. Its general ground-color is pale yellowish brown. The broad stripes are dark brown or black, and do not extend so far on the limbs and on the tail as they do in the mountain zebra.

Experiments have proved that the zebra can be made to work well in harness if properly treated, but it has never been truly domesticated. The flesh is eaten by the natives, and the hide is used for leather.

Burchell's zebra is often erroneously called the quagga. The true quagga, however, is a different animal which formerly abounded in herds on the plains south of the Vaal River but is now extinct. It was more like a horse and was of stouter build than the zebra, reddish brown in color, with dark stripes on the head, neck, and shoulders.

ZEBU (*zē'bū*). The humped ox of India, called by foreigners the zebu, is no longer found in the wild state, but has become thoroughly domesticated. It possesses a well-marked hump of fat on the shoulders, which is considered a delicacy for the table. It has long ears pointing downward and very short blunt horns. Zebus are used for plowing, hauling, riding, and for milk. White bulls of this breed are held sacred by the Hindus. Under the name of "Brahman" cattle, zebus have been imported into Texas and crossed with native stock (*see* Cattle). Scientific name, *Bos indicus.*

ZEUS (*zūs*). The greatest of the deities in classical mythology was called Zeus by the Greeks, Jupiter or Jove by the Romans. He was the father of gods and men, protector of kings and supporter of law and order, the avenger of broken oaths and other offenses; he watched over the state and the family and over strangers and suppliants; his hand wielded the lightning and guided the stars; he ordained the changes of the seasons, and regulated the whole course of nature.

The son of Kronos and Rhea, Zeus, according to the ancient story, expelled his father and the older dynasties of the Titans, assumed the sovereignty of the world, and successfully resisted the attacks of the giants and the conspiracies of the gods (*see* Uranus). After the dethronement of the Titans, Zeus was allotted the empire of heaven and air, Hades (Pluto) of the infernal regions, and Poseidon (Neptune) of the sea, while the earth was left under the joint power of the three.

Zeus himself, however, was supreme over all. To his palace on Mount Olympus all the gods repaired to take counsel and to settle the affairs of men. The power and majesty of the ruler of the world is expressed in Homer's famous lines:

> Zeus spake, and nodded with his shadowy brows;
> Waved on the immortal head th' ambrosial locks,
> And all Olympus trembled at his nod.

The wife of Zeus was Hera (Juno), the queen of heaven, and their union was regarded as the divine type of all earthly marriage. It is true that, according to many of the myths, Zeus was not always faithful to Hera but had numerous other love affairs; some authorities explain this by the fact that to Zeus have been ascribed attributes and adventures properly belonging to other gods that came to be identified with him.

As judge and ruler Zeus was pictured as seated upon a throne, in his hand a scepter. As commander of the forces of nature he was represented as riding in his thunder-car, wearing the aegis or breastplate of stormcloud (sometimes worn also by Athena), hurling the thunder-bolt and the lightning scourge. To him the eagle, the mighty oak, and the mountain peaks were sacred.

The highest achievement in Greek sculpture was said to have been the statue of Zeus by Phidias. It was a colossal image of ivory and gold, 40 feet in height, occupying the place of honor in the great temple of Zeus at Olympia. Many descriptions of its splendor and beauty have come down to us, and its design is well known from its image stamped on certain Greek coins.

THE FATHER OF THE GODS

Zeus, or Jupiter as the Romans called him, was the chief god, the one omnipotent being, in classic mythology. He was regarded as the *father of gods* as well as of men. In fact his Latin name, Jupiter, means "Zeus the father" (*Zeus pater*).

ZINC. Most of us have noticed the coating of zinc on buckets, rainspouts, wire fences, and other things made of galvanized iron or steel. But few of us realize in how many other ways we use zinc. All brass contains zinc. Typewriter frames, safety razor holders, and automobile horns, radiator grilles, and door handles are but a few of the die castings made of zinc alloys. The paint on the walls of our houses and the ointments and powders in our medicine cabinets probably contain zinc. But in most of its countless applications its identity is concealed. In fact, zinc is one of the least noticed of all the useful metals.

For hundreds of years, indeed, men were using zinc without knowing what it was. The Romans fused its ores with copper to make brass. Apparently the first to recognize zinc as a distinct metal were the Hindus and the Chinese. By the 16th century, Portuguese traders were bringing zinc bars to Europe from the Orient. Perhaps the first European to produce metallic zinc was Georgius Agricola. In his work 'De Re Metallica' (1556), he tells of finding "zincum" in furnace crevices while smelting lead and copper ores.

The process of galvanizing iron consumes a large share of the zinc of commerce. Immersion in molten zinc gives the iron a rustproof coat. In the process of electrogalvanizing, the iron is electroplated with zinc (*see* Electroplating).

The making of brass usually ranks second in the use of zinc, for the different types of brass contain from 30 to 45 per cent of zinc (*see* Copper and Brass).

Die-casting also consumes large amounts of zinc. Typical alloys used for this purpose contain 90 per cent or more of zinc with small quantities of copper and aluminum. Die castings of these alloys are light and durable and require but little finishing.

For many purposes, zinc is simply flattened into sheets called rolled zinc. This is used to make roofing, battery cans, refrigerator linings, photoengraving sheet, and tops for glass jars.

The compounds of zinc have important uses. Zinc oxide, or zinc white, is used in paint to give it body and make it opaque (*see* Paints and Varnishes). It is used in rubber to make it heat resistant. Zinc chloride is used in soldering flux, and zinc sulphate in fungicides and insecticides. Zinc compounds are used also in medicines and toiletries.

Ores and Producing Regions

The chief ores are zinc blende or *sphalerite* (a sulphide), *smithsonite* (a carbonate), *calamine* (a silicate), and *franklinite* (an oxide). At the smelter the zinc is distilled from the crushed ore. This is done by heating the ore with coal in retorts, thus freeing the zinc as a vapor, which is finally condensed. The metal is then poured into molds, where it solidifies into slabs called spelter. Zinc is also separated from the ore by electrolysis (*see* Electrochemistry).

The United States leads the world in zinc production. The chief mining center is the Joplin region, where Oklahoma, Kansas, and Missouri meet. New Jersey, Tennessee, Virginia, Idaho, and New York have deposits of commercial value. Important foreign producers are Germany, Belgium, Canada, Australia, the United Kingdom, Russia, and France.

Though the world has abundant reserves of zinc ore, the normal output is not enough to meet the needs of nations in times of war. This is so because much zinc is needed for brass in cartridges, shell cases, and other munitions. Rolled zinc and galvanized iron find wide use in camp equipment. Zinc is therefore considered

a "strategic material," and nations at war severely curtail its civilian uses.

Pure zinc is bluish white and fairly soft. With a specific gravity of 7.12, it is almost as heavy as tin. The melting point of zinc is about 787° F., and its boiling point, exceedingly low for a metal, is about 1,665°. Chemical symbol, Zn. Atomic number, 30. Atomic weight, 65.38. Valence, 2.

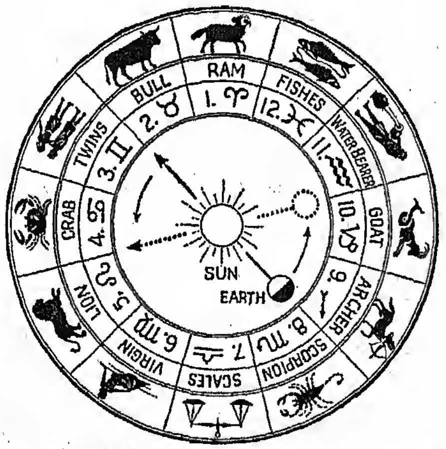
ZODIAC. The apparent annual path of the sun in the sky lies through 12 constellations or groups of stars, and the zone which these stars occupy is called the zodiac. Within this zone, likewise, are found the orbit of the moon and the paths of the principal planets. The zodiac was regarded with superstitious awe by the ancients, and the various movements of the sun, moon, and planets through the zodiac formed the basis upon which astrologers predicted the future and cast horoscopes. To make the list of constellations of the zodiac easy to remember, the following rhyme was invented:

The Ram, the Bull, the Heavenly Twins,
And next the Crab the Lion shines;
The Virgin, and the Scales,
The Scorpion, Archer, and the Goat,
The Man that Bears the Watering Pot,
And Fish with glittering tails.

Usually, however, they are known by their Latin names: Aries (Ram), Taurus (Bull), Gemini (the Twins), Cancer (Crab), Leo (Lion), Virgo (Virgin), Libra (the Balance, or Scales), Scorpio (Scorpion), Sagittarius (the Archer), Capricornus (Goat), Aquarius (the Water Bearer), and Pisces (the Fishes).

As a result of the shifting of the equinoxes, the sun is now a whole constellation behind the appropriate sign. For example, at the beginning of spring the sun is said to enter the sign of Aries, but as a matter of fact it is still in the constellation Pisces. Two thousand years ago, however, the signs and the constellations exactly corresponded, which will not again be the case for about 25,000 years. (*See also* Astronomy; Constellations.)

THE SIGNS OF THE ZODIAC



The Latin names of the signs from 1 to 12 are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricornus, Aquarius, and Pisces. The central diagram shows why the sun is *in a different sign every month of the year.*

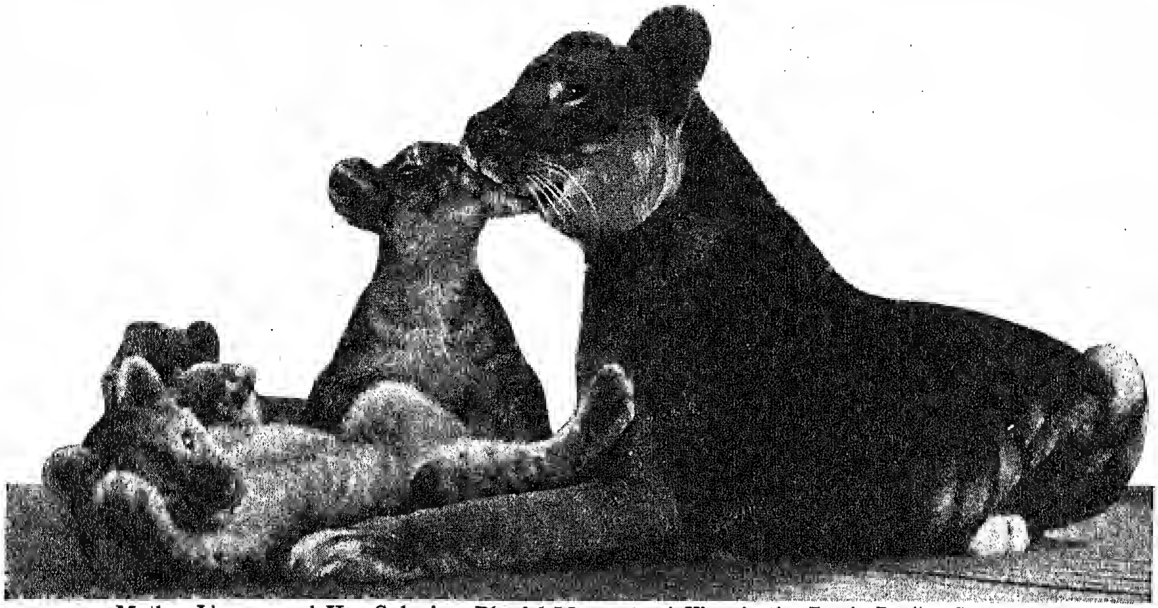
ZOLA (*zō'lȧ*), **ÉMILE** (1840–1902). In a certain sense this French novelist resembles those sages of ancient times who one day sat down to write into a book everything that was known in all the world. Zola's ambition did not quite swallow up the whole world, but he did set out to show the workings of the laws of heredity in human society, and to this end produced some 20 volumes composing the Rougon-Macquart series of novels. "Heredity has its laws, just as weight has," he declared, and in his novels he sought to show how a character who had inherited certain tendencies, and who was then placed in certain surroundings, must develop and flourish or perish according to the strength or weakness he had inherited and the circumstances about him. This was not such a new idea anyway; and unfortunately for his reputation, Zola selected chiefly those individuals whose inheritance was weak and vicious, and placed them in situations which only served to drag them through crime, baseness, and social mud, and to bring out the points the author wished to prove.

However, whether this series of novels is pleasing or not, it is great as a huge picture of the side of life it presents. There is a strong sense of great masses of people, a clear taking-off of events and customs, occasional beautiful descriptions, and much keen insight into the frailties and struggles of the human spirit. Zola, together with Flaubert, Daudet, the Goncourts, Fabre, and others, formed what is known as the "naturalist school" of French writers. That is, they tried to show life just as it is naturally, without any comment from themselves. But Zola at least, in showing people as passive animals, slaves of heredity and of their own weak nerves, brutal and base, does not draw a picture of life which everyone would call perfectly "natural." Some of his novels outside the Rougon-Macquart series, and his short stories and plays, are of a more agreeable type.

Zola was born in Paris, of a French mother and an Italian father, a distinguished civil engineer. He spent his boyhood at Aix, and was educated at Paris, where he failed to graduate from the *lycée*. While wandering through the Paris streets looking for employment, sometimes without two sous to jingle together in his pocket, he composed the beginnings of his first published work. Better days came when his abilities were recognized, as was speedily the case. In the latter part of his life he courageously defended the cause of Captain Dreyfus in that famous and disgraceful affair and probably did more than anyone else to right the wrong done that unhappy man; but for his writings on the subject he was for a time exiled by the guilty public officials, and some of his works were suppressed.

Zola's best known works are: 'Contes à Ninon' (1864); 'Thérèse Raquin' (a play), 1867; 'Les Héritiers Rabourdin' (The Rabourdin Heirs), a farce, 1874; the Rougon-Macquart series (1871–1893), including 'L'Assommoir' (The Dramshop), 1877, 'Germinal' (1885), 'La Débâcle' (The Downfall), 1892, and many others; 'Nana' (1880); a trilogy, 'Les trois villes' (The Three Cities), including 'Lourdes' (1894), 'Rome' (1896), 'Paris' (1898); and another series, 'Les quatre evangiles' (The Four Gospels), including 'Fécondité' (Fruitfulness), 1899, 'Travail' (Labor), 1901, 'Vérité' (Truth), 1902. The last volume of this series was to have been called 'Justice', but it was never completed.

WILD ANIMALS *of the World*—A VISIT *to the* ZOO



Mother Lioness and Her Cubs in a Playful Moment. A View in the Zoo in Berlin, Germany

ZOÖLOGICAL GARDENS. The marveling multitudes who stream annually through the zoos of the world can have little idea of the hardship and desperate adventure men endure to capture the many wild beasts; of the weary journey to transport them from their savage haunts to the exhibition parks; of the heavy cost of their upkeep; of the skill and expert care required to keep the animals healthy and induce them to rear young; still less, of the wide activities in research and instruction carried on in modern zoölogical gardens.

It is the mission of the zoölogical garden "to gather together specimens of animals from all parts of the world, and exhibit them under sanitary and humane conditions that the millions of people may look upon them, and be instructed and entertained." In a well-kept zoo most animals are better off than their brethren in the wild. They are treated with kindness, fed regularly, protected from enemies, safeguarded against cold and disease, and cared for in sickness. Under such conditions they often live longer than they would in the wilderness, where ever-present dangers threaten their lives. The great majority of wild animals destined for zoölogical gardens are captured when young. If taken at an early age they adapt themselves more readily to captivity, and are more easily handled and tamed. Some are secured by ranchers or natives; many by professional animal catchers, whose trade is far flung and dangerous, but highly exciting.

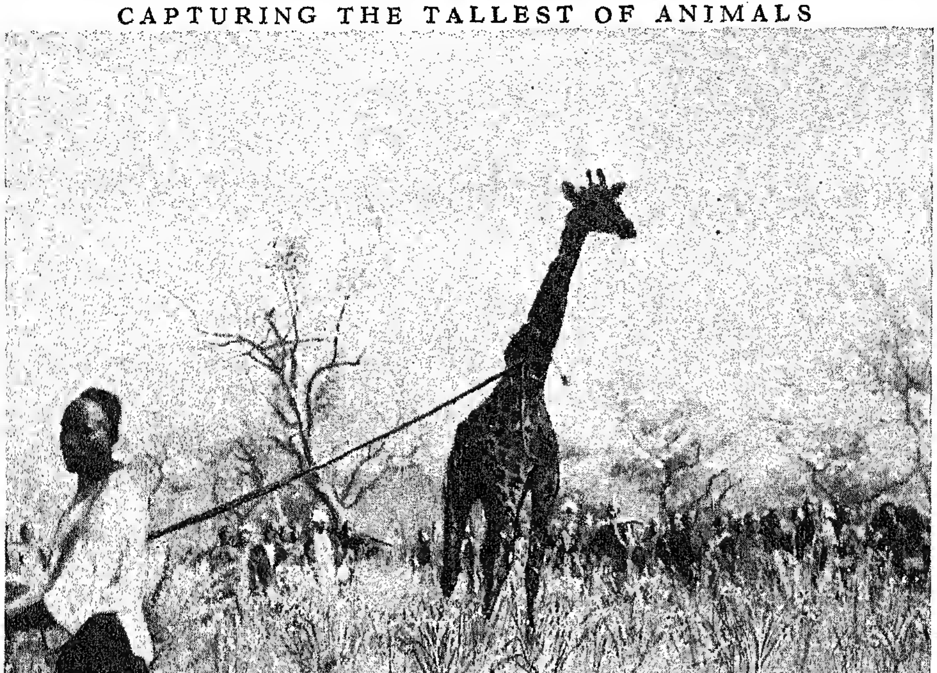
GUESTS FROM THE ARCTIC

Bears give birth to one or two cubs during the winter. Here shy "Nanook," the three-months-old cub of "Sultana," famous Polar Bear of the Milwaukee Zoo, enjoys its first spring sunshine.

Perhaps in Sumatra a lone white adventurer is creeping silently through the haunts of the orang-utan, in the hope of capturing her nursing young. Elsewhere in the Malay Archipelago a hunter may be spreading his net, baited with fowl, to ensnare a leopard. In India, some explorer is perhaps slipping a noose around an 18-foot python; while in Africa a safari may be setting out to bring back a lion trapped in a concealed pit.

The director of the Philadelphia Zoölogical Garden tells of the difficulties met in securing an Indian rhinoceros. First of all, special permission had to be obtained from the maharajah of Nepal before the collector was allowed to enter a country where white men are barred. Large corrals were built and the animals driven into them. The old rhinos were then released, and the young calves captured. Two

CAPTURING THE TALLEST OF ANIMALS



The Giraffe, whose head reaches 18 or 19 feet above the ground, dwells in the bushy plains country of Africa where he loves to browse on the crowns of acacia trees. He is captured by hunters on horseback. This towering animal, led by a rope around his neck, was taken for the zoo at Washington, D. C.

were placed in log crates and hauled 30 miles over rough roads on two-wheeled carts drawn by Indian buffaloes. Two huge elephants were taken along, laden seven feet high with food for the rhinos. The trip consumed three days. Arriving at Rexal, the crates were placed on a flat car running on a narrow-gauge railroad which took them to the banks of the Ganges River. The animals were transferred to a steamboat sailing to Calcutta, where they were again shifted to another boat, and eventually, after a very rough passage, were landed at San Francisco. From there they were taken across country by train and placed on exhibition, one in Philadelphia, the other in New York. The Philadelphia specimen was only an infant about two and one-half years old when received, but it weighed about 640 pounds!

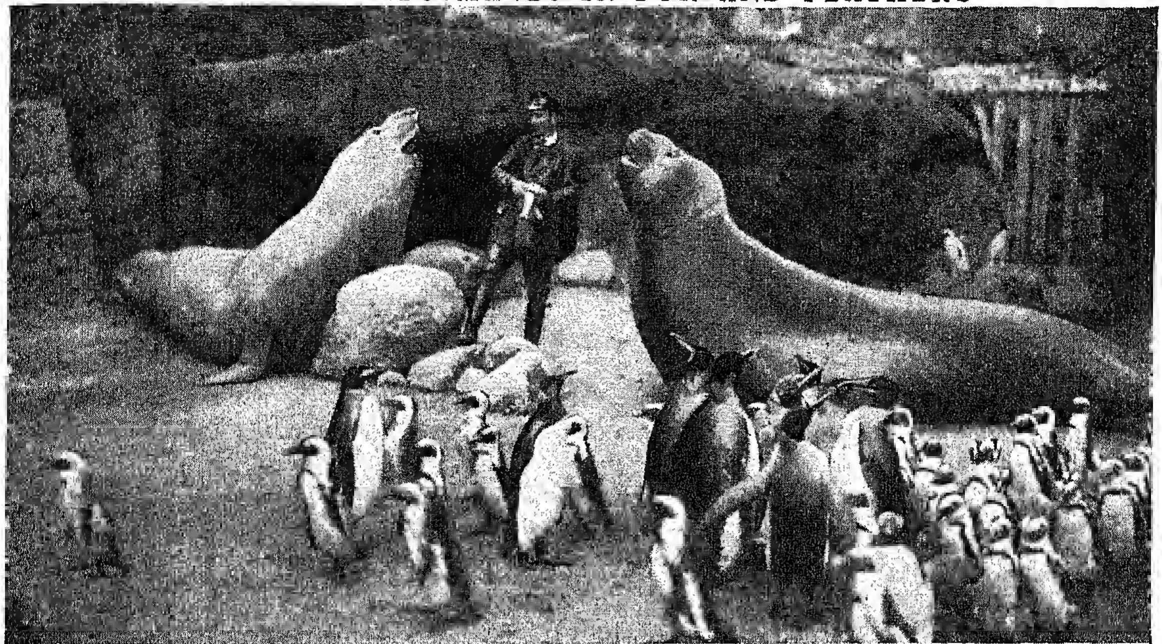
Hamburg, the headquarters of the firm of Carl Hagenbeck, is the greatest port of wild animals in the world. There you may see a tramp steamer from Singapore unloading cages of black leopards and orang-utans, gibbons and tigers; or a freighter docking from South America with jaguars, monkeys and macaws, peccaries and armadillos on board. From West Africa comes a curious cargo of chimpanzees, cobras, and wart hogs; from Cape Town a shipment of giraffes, antelopes, elephants, lions, and rhinoceroses. Musk oxen from Greenland, polar bears from Fridtjof Nansen Land, tortoises from the Galapagos, birds of paradise from New Guinea—from all over the world wild creatures are brought to Hamburg to be distributed over Europe and America and eventually to find a home in some zoo, circus, or with private individuals.

New York is the second greatest port of wild animals. There are several well-known dealers there from whom one can buy nearly anything that runs, flies, or creeps, from a kangaroo to a kittiwake, a horned toad to a hippopotamus. As a rule, the newly incoming stock is sent to quarantine and conditioning stations. One such is located at Larchmont, N. Y., another at Nashua, N. H., others on Long Island, in New Jersey, and elsewhere. These

A "NOSEY" PAIR

These dull-witted, grayish-black creatures are Great Brazilian Ant-Eaters whose long sticky tongues raided many an ant hill at home; but in the zoo at Toledo, Ohio, they learned to get along on a diet of raw eggs.

STRANGE MESSMATES IN FUR AND FEATHERS



Southern Sea-Elephants, brought from the Antarctic to Hagenbeck's Tierpark in Germany, share this artificial rocky beach with King Penguins and the smaller Jackass Penguins, all eager for the freshly caught fish that form their mainstay at every meal.

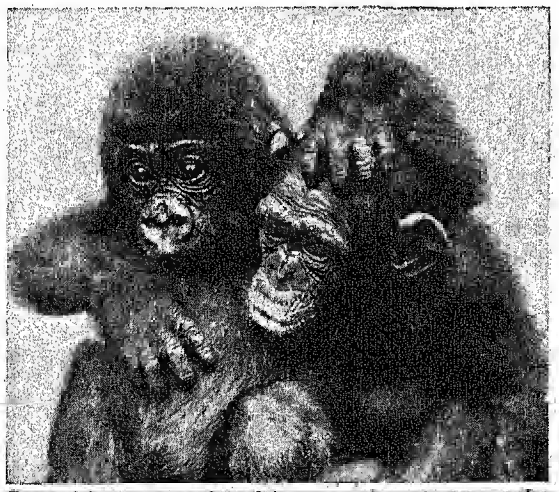
"farms" are under the inspection of the Department of Agriculture.

Most of the specimens entering the country come to dealers from their agents in foreign lands, though some find their way to port as property of the ship's crew. These are usually parrots, monkeys, or sometimes a chimpanzee or other valuable animal.

The problem of stocking a zoo is not the most difficult part of a director's job. Gifts of rare animals are often received from foreign consuls, missionaries, and tourists in remote lands. New animals are also acquired through exchange with other zoos. One curator, successful in breeding antelopes, for example, may negotiate a trade with the head of another zoo for an extra bald eagle or cheetah. A recent report of the National Zoölogical Park shows additions of 479 specimens for one year. Of these, 230 were donations, 99 were born in captivity, 68 were received in exchange, 80 were purchased, and 2 were left on deposit.

The market prices for wild animals vary widely, and may run all the way from the low price of 25 cents for a box turtle to $18,000 for an Indian rhinoceros. Bears may be had for $350, a mature lion may bring from $700 to $1,000, an Indian elephant from $1,500 to $2,500. Ordinary monkeys such as the Indian rhesus and the common South American ringtails may be sold for as little as $10, but a big male Gelada baboon or a mandrill will cost $600 to $1,000, and a gorilla from $3,500 to $10,000. Snakes are sold by the foot or by the yard, while giant tortoises are sold by weight. Prices depend on age, sex, size, and health, and are largely governed by the law of supply and demand. A 10-foot giraffe (the usual size imported) is obviously expensive because it cannot be carried in a railroad car. Landed in the United States, it is worth $6,000. Think too of the freight charges for transporting a hippopotamus from the Sudan to Kansas City or Los Angeles!

"WHEN A FELLER NEEDS A FRIEND"



Perched in the arms of its Chimpanzee playmate, this wistful Baby Gorilla satisfies its desire for companionship, without which it soon dies in captivity. Note the large ears of the Chimpanzee, and the broad flat nostrils of the Gorilla.

Some animals are rare because they live in such out-of-the-way places that it is necessary to organize special expeditions to get them. Others, on the verge of extinction, are protected by law, and permits to

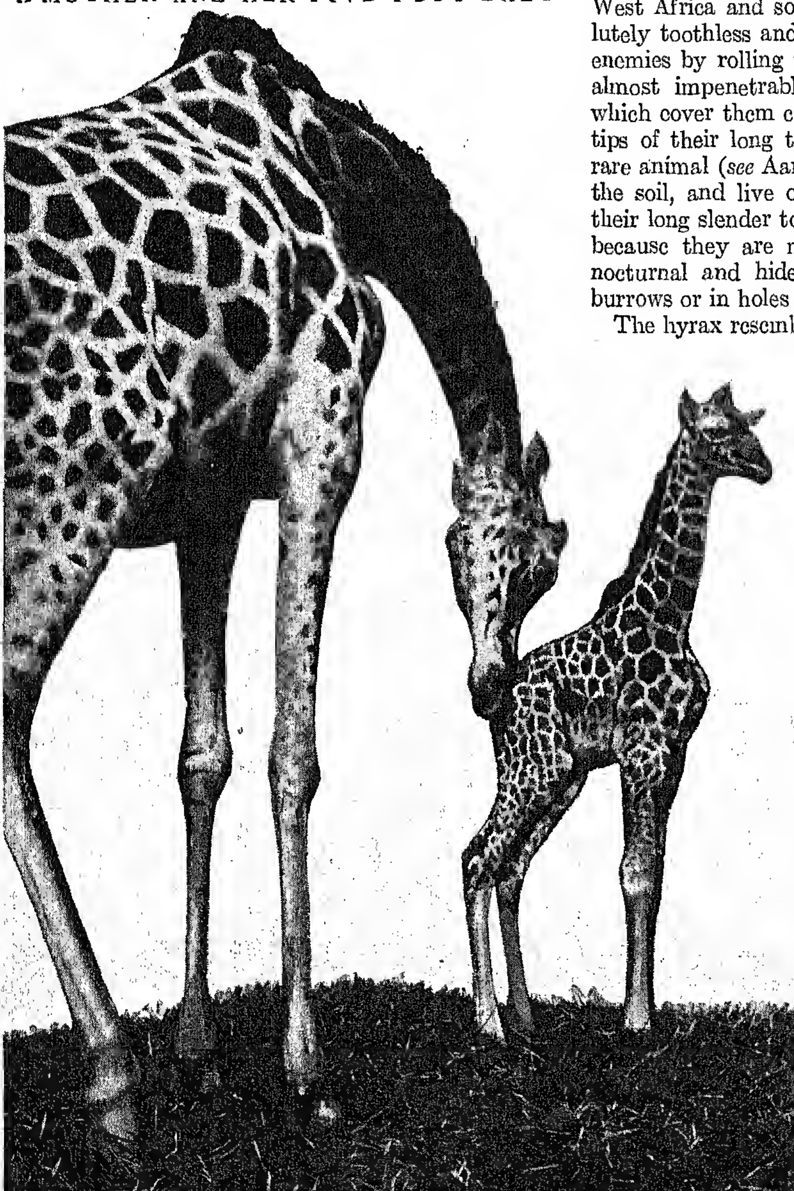
capture them are practically unobtainable. Still other creatures are extremely difficult to transport or to keep in captivity, either because they are too temperamental, too specialized in food habits, or too delicately attuned to a certain environment.

One of the rarest animals is the giant, or short-tailed, panda of Tibet. The specimen obtained by the Chicago Zoölogical Park in 1937 was the first one ever exhibited in a zoo, although the giant panda has been known to science since 1868. Its markings are strikingly beautiful: fur mostly white; black legs, ears, and eye-patches, with a broad black stripe across the shoulders. The panda is sometimes called the bear cat, because it has some of the characteristics of bears and cats, though it is more nearly related to the raccoon. The long-tailed panda, more commonly seen in captivity, is a smaller animal, rusty red in color, and about the size of a large cat.

Among animals seldom seen in zoölogical parks are the duck-billed platypus of Australia, the echidna, the proboscis monkey of Borneo, the spectacled bear of the Peruvian Andes, the pangolin or scaly ant-eater, the hyrax of Africa, Arabia, and Syria, and the kiwi, a curious New Zealand bird.

The pangolins are wonderful creatures confined to West Africa and southeastern Asia. They are absolutely toothless and unable to fight, but baffle their enemies by rolling up into a ball and presenting an almost impenetrable armor of sharp horny scales which cover them completely from their noses to the tips of their long tails. Like the aardvark, another rare animal (*see* Aardvark), they dig rapidly through the soil, and live on ants which they capture with their long slender tongues. Pangolins are rarely seen because they are not only scarce, but are strictly nocturnal and hide away during daylight in deep burrows or in holes in trees.

A MOTHER AND HER FIVE-FOOT BABY



This Baby Giraffe, only three days old, but already five feet nine inches tall, proudly poses with his watchful mother in the New York Zoölogical Gardens in Bronx Park.

The hyrax resembles the rabbit in size, habits, and superficial appearance, lives in rocky places, and is sometimes called the "rock rabbit"; but because of the peculiar formation of its teeth and feet, it is considered by some scientists to be most closely related to the rhinoceros, tapir, and horse among living animals. The hyrax is a primitive ungulate somewhat like the five-toed ancestor of the horse.

The kiwi or apteryx is a tailless and practically wingless bird, with coarse hairlike feathers, short neck and legs, and a long bill with nostrils at the tip. It runs rapidly, is about the size of a domestic fowl, lays one or two enormous eggs a year, makes sounds resembling the growls of a dog, and all in all, is one of the strangest birds known to man, and one of the most primitive.

Some animals, like the moose, are common enough in the wild state, but will not live in captivity. Hoofed animals from regions where certain communicable diseases occur, such as the hoof and mouth disease, cannot be imported into the United States because of the

danger of infecting domestic animals. This excludes such ungulates as the gayal, the banteng, and the musk deer.

The trouble with a young captive gorilla is wholly mental. In a cage it soon languishes and dies, but if reared as a pet in the home, and treated as a child, it will live contentedly. Social life is apparently vitally necessary to it.

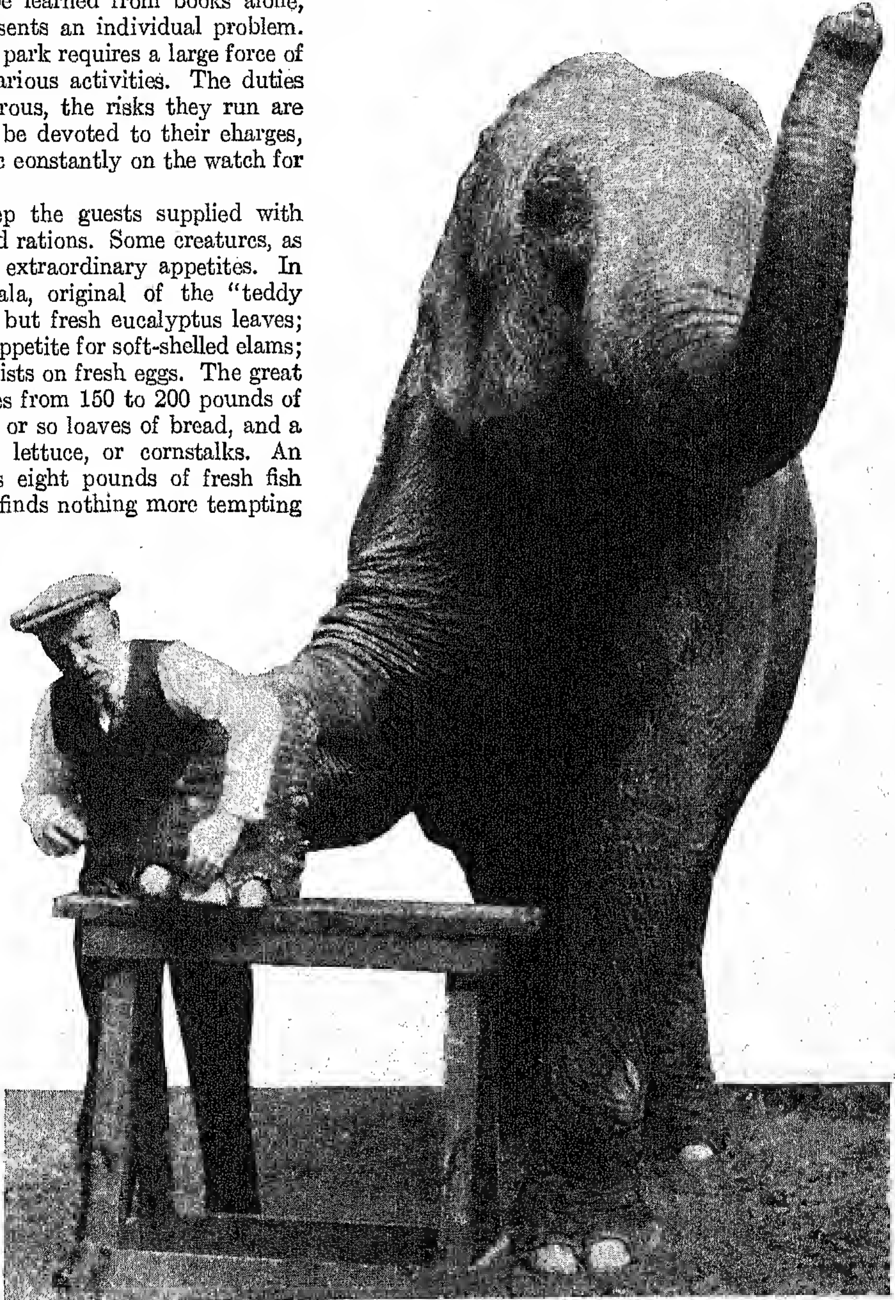
The care of animals in captivity is a specialized science which cannot be learned from books alone, since each creature presents an individual problem. The ordinary zoölogical park requires a large force of "keepers," skilled in various activities. The duties of caretakers are numerous, the risks they run are often great; they must be devoted to their charges, understand them, yet be constantly on the watch for trouble.

It is difficult to keep the guests supplied with proper and well-balanced rations. Some creatures, as may be expected, have extraordinary appetites. In the Bronx zoo, the koala, original of the "teddy bear," will eat nothing but fresh eucalyptus leaves; the walrus has an avid appetite for soft-shelled clams; and the gila monster insists on fresh eggs. The great African elephant requires from 150 to 200 pounds of hay daily, with a dozen or so loaves of bread, and a huge salad of cabbage, lettuce, or cornstalks. An 80-pound sea-lion needs eight pounds of fresh fish daily; the land tortoise finds nothing more tempting than bananas; and the big python demands a 40-pound pig for a meal, but this satisfies him for several months.

For many animals the diet must be varied from day to day. Monkeys and bears want a variety of foods. Although lions and tigers scorn everything except raw meat, many other captives will eat cooked food, and this is desirable since cooked foods are more sanitary and less liable to cause intestinal disorders. Every zoo has a kitchen in which food is prepared for the many finicky guests. Up-to-date zoos also have a bakery. In the Milwaukee Zoölogical Garden a special bread consisting of a mixture of wheat, bran, and molasses is baked in 10-pound loaves. One thousand pounds are baked daily and fed chiefly to the 38 bears in the zoo.

Clean cages, proper warmth and ventilation, are other important concerns. The zoo veterinarian has an exciting job. He may be called upon to pull an elephant's tooth, lance the jaw of a rhinoceros, operate on a cobra's eye, treat the infected hoofs of a zebra,

A LARGE MANICURING CONTRACT



Zoo Elephants develop lameness unless their hoofs are regularly treated to a manicure. Here a keeper at the Franklin Park Zoo in Boston performs this duty for patient "Waddy," who seems to like it.

or fit a plaster cast to the broken leg of a Bengal tiger! Medicine is given sick animals, and keepers say that most animals relish a dose of cod-liver oil.

The first zoo of which we have any record was founded about 1100 B.C. by the Chinese emperor Wu Wang. Its name, "Intelligence Park," seems to indicate that the animals were kept for an educational or scientific purpose. Collections of wild beasts were maintained by the ancient Greeks and Romans, mostly for their gladiatorial combats. During the Middle Ages, princes and feudal chieftains kept menageries and aviaries. Some of the Aztec rulers of Mexico in the 15th and 16th centuries maintained collections of wild animals, as did also the Inca of Peru who domesticated the llama, the alpaca, and the guinea-pig.

The famous zoo of the Zoölogical Society of London was founded in 1826. It is noted for possessing the most comprehensive exhibit of birds, beasts, and reptiles in existence. At the London zoo many modern methods were first devised, such as the use of artificial sunlight, radiant heat, and windows of vita-glass to admit ultra-violet light. Excellent zoölogical gardens are to be found in Antwerp, Rotterdam, Amsterdam, Berlin, Hamburg, Hanover, Frankfort, Cologne, Paris, Rome, Vienna, Copenhagen, Lyons, Marseilles, and several other European cities. Australia has zoölogical parks at Melbourne, Sydney, Adelaide, and Perth. Good collections are also displayed in Tokyo, Buenos Aires, Rio de Janeiro, Lima, at Alipore, near Calcutta, in Bombay, India, and in Rangoon, Burma.

RARE SPECIMENS FROM DISTANT PLACES

The Himalayan Long-Tailed Panda, of the raccoon clan, above, lives in the National Zoo at Washington, D. C. Left, is that strange wingless bird, the Kiwi, and right, another Australian rarity, the beloved "Teddy Bear" or Koala.

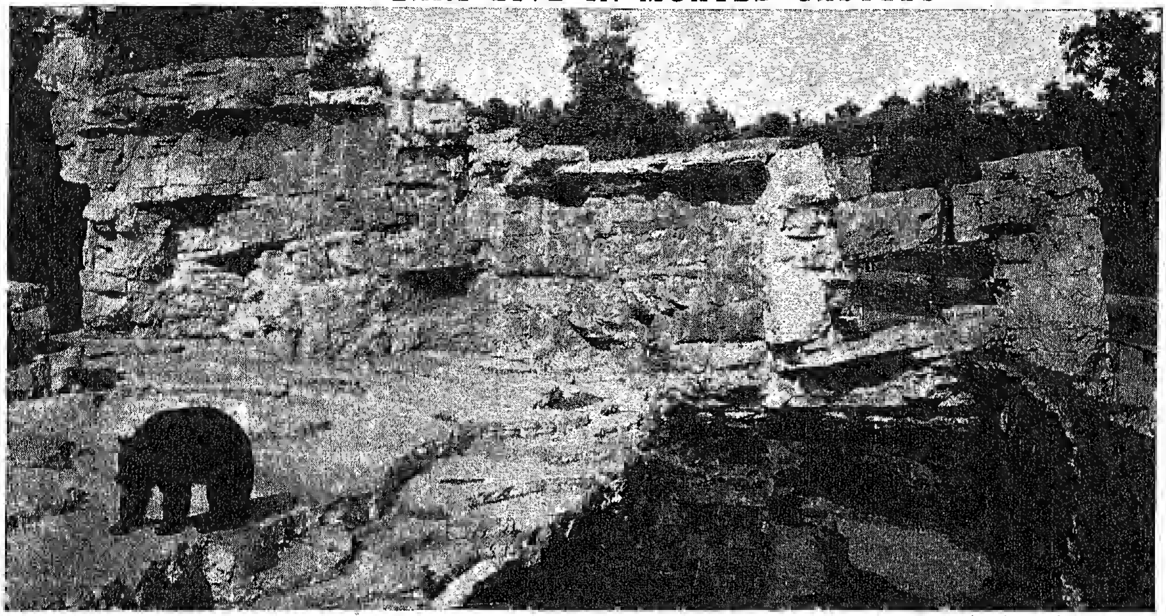
The New York Zoölogical Garden in Bronx Park is the largest in the world, comprising nearly 300 acres. It usually has about 4,000 animals. The Philadelphia zoo, oldest in the United States, was opened in 1874, and has about 3,300 living specimens. The National Zoölogical Park at Washington, D. C., under the direction of the Smithsonian Institution, is noted for its splendid site which provides approximately natural living conditions for many kinds of animals. Chicago, Cincinnati, Buffalo, Detroit, Pittsburgh, Milwaukee, St. Louis, San Diego, San Francisco, and other cities in the United States also maintain good collections. Similar gardens are also to be seen in Ottawa, Montreal, Quebec, Toronto, Vancouver, and some other Canadian cities.

The old-fashioned zoölogical garden was mainly an animal prison for show purposes, where the captives languished behind the bars of small cages. The modern gardens, like those in New York and Washington, endeavor as far as possible to keep the animals under nearly natural conditions in large outdoor enclosures suited to their size, temperament, and activity. Here they live a healthful and contented life, receive the best of care and of food, and frequently rear families.

A zoo without bars is the startling achievement of the famous Hagenbeck Tierpark at Stellingen, near Hamburg, Germany. Bears, lions, wolves, and many other animals can be observed in an outdoor setting of rocks and trees. The animals have ample room for exercise and play in barless enclosures separated from the public by moats, walls, and embankments, of a size nicely calculated beyond the leaping and climbing abilities of the animals. Artificial rock work gives the illusion of natural dens for the bears, tall crags for the goats, and grottoes for tigers, leopards, and the like. Carl Hagenbeck was the first zoo manager to associate various species of unrelated animals together in a common enclosure. In his barless "African Steppe" he exhibits herds of zebras living with elands, gnus, blesbok, gazelles, ostriches, wart hogs, and other animals.

To some extent the barless type of construction has been employed at St. Louis, Detroit, and other places in the United States. One of its most notable developments is in the Chicago Zoölogical Park, opened

WHERE BEARS LIVE IN MOATED CASTLES



Picturesque moated dens, like this one in the St. Louis Zoölogical Park, have an intervening stretch of water in place of bars, and overhanging walls of rock work, which keep the public safe from the Bears, and the Bears safe from the admiring public.

in 1934, in the Chicago suburb of Brookfield, Ill. This zoo, founded by the Chicago Zoölogical Society under the presidency of John T. McCutcheon, and built on land given by Mrs. Edith Rockefeller McCormick, has many unusual features. Most of the birds, of course, are confined in a spacious flying cage, and the reptiles are kept in a special house with glass-fronted compartments; but for other animals barless enclosures have been provided wherever desirable and practicable.

One feature of the barless zoo is the interesting association of animals that may be seen in panorama. By proper disposal of canals, pits, and "islands," herds of bison, wapiti, white-tailed deer, pronghorn antelope, American goat, and bighorn, apparently seem to mingle with such animals as the cougar, the plains wolf, and the grizzly bear. A cougar, for example, can be shown in a grotto, in the side of the artificial mountain, with sheep and goats ranging above and below him. Smaller grottoes for prairie-dogs, raccoons, wolverines, and badgers can be incorporated in the mountainside or plains part, according to their habitat. Thus the characteristic animals of the North American plains and mountains can be shown in one grand panorama, each kind isolated from the other, yet without any visible bars or cages to dispel the illusion of perfect freedom.

A LEAP THAT FAILED

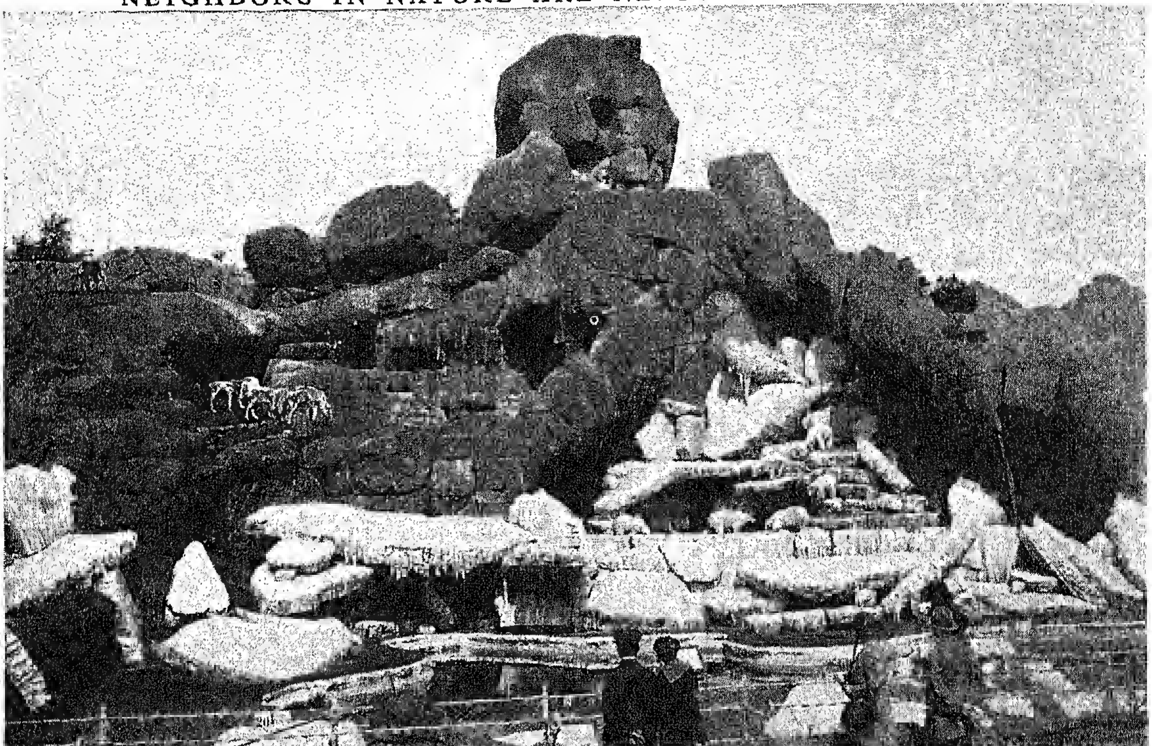
Here a Polar Bear in the London Zoo tried to hurdle the pit and landed at the bottom. Her mate above looks down curiously.

With the introduction of the barless construction the zoölogical garden has entered a new epoch. But modern zoos do not confine themselves solely to the show business. Scientists studying wild life in zoölogical gardens have made valuable contributions to our knowledge of animal structure and habits. The zoo has particularly become a laboratory for students of animal psychology. Sculptors and painters likewise go to the zoo for inspiration and living models.

Then, too, the larger zoos often have an educator on the staff to give lectures to school children and other visitors. With the zoo for a background many valuable truths can be taught: the economic and geographical features of the countries whose fauna is represented; the necessity of preserving harmless wild animals to maintain the balance of nature; the importance of birds and reptiles in destroying crop pests; and many other valuable educational lessons.

Animals that are rapidly disappearing from their native haunts have been protected from extinction in zoös, where they frequently thrive and rear young. The surplus stock

NEIGHBORS IN NATURE ARE NEIGHBORS IN THE ZOO



The Hagenbeck Tierpark features a grand panorama of all zones of the earth with their characteristic animals. The "Northern Province," shown here, provides a range for Reindeer at the left, adjoining imitation ice caves for Polar Bears at the right.

is then used to repopulate areas where these animals were formerly abundant.

Even after death the specimens serve a useful purpose. An autopsy is often performed by specialists; the animal's anatomy, parasites, or diseased conditions are investigated, and in the case of rare animals, the skin is preserved and mounted for museum display.

Turning from a survey of animal life in the zoölogical park, visitors may often pass over to the adjoining botanical garden, where labeled collections of living plants, both native and exotic, are arrayed in beautiful profusion. These two types of biological institutions perform similar educational functions—one is organized for the study and display of animals, the other for the study and display of plants.

The first botanical garden in America was that of John Bartram, laid out in 1728 on the banks of the Schuylkill River, in Philadelphia. The Missouri Botanical Garden at St. Louis, the New York Botanical Garden in Bronx Park, the Arnold Arboretum on the outskirts of Boston, and the Brooklyn Botanical Garden are outstanding institutions of this type in the United States. Famous botanical gardens in Europe are the Jardin des Plantes, in Paris, the Royal Gardens at Kew, near London, and those at Oxford, Dublin, and Edinburgh. Greenhouses or conservatories, and a herbarium where dried plants are systematically arranged for study, usually supplement the outdoor garden.

PREPARING THE MONKEYS' BILL OF FARE

Keepers preparing a meal for Monkeys at the Milwaukee Zoo select a varied diet which differs somewhat for different kinds of Monkeys. Bran bread, bananas, apples, carrots, peanuts, sunflower seeds, lettuce, potatoes, and rice form the common menu, with onions and cod-liver oil once weekly, and at times fresh milk and eggs.

ZOÖLOGY. Animal life, from the amoeba up to man, is the subject of zoölogy, which is one of the two main divisions of the science of biology (*see* Biology). In the present-day study of zoölogy, attention has been directed from the external appearances of animals—as shape, color, differences in horns, hoofs, etc.—to their internal structure and life processes. An attempt is being made to analyze their vital activities and to determine their position in the history of the universe. So the zoölogist is no longer a mere collector and classifier of animal specimens. That which is best and strongest in modern zoölogy is being worked out in the laboratories by experiments and observations. These studies, especially in the last half-century, are leading to large generalizations regarding the science of life, which should become known to all people of liberal culture.

The Greek philosopher Aristotle (384–322 B.C.) has been called the "Father of Natural History," which includes zoölogy. He was a man of truly scientific mind and made many original observations on the structure and development of animal life. The Roman, Pliny the Elder (23–79 A.D.), also wrote on zoölogy; but he was less scientific, mixing borrowed facts, fancy, and fabulous stories with his own observations. The revival of anatomy by Vesalius in the 16th century (*see* Anatomy) greatly helped zoölogy by giving a knowledge of structure, the study of which was gradually extended downward from the higher animals to the lower forms. Swammerdam (1637–1680) advanced the science by his dissections and life history studies. The development of the microscope, from the 17th century on, gave remarkable impetus to the study of minute animal forms and structures.

The systematic classification of animals (as well as plants) owes much to the Swedish naturalist Linnaeus (1707–1778). The French zoölogist Buffon (1707–1788), who was a man of more philosophical mind than Linnaeus, created a popular interest in the subject by his graceful writings, and also opened up new fields and led the way in some matters of great importance. His countryman, Georges Cuvier (1769–1832), laid the foundation of the comparative study of the structure of animals (comparative morphology); and another countryman, Lamarck (1744–1829), was the most noteworthy of the predecessors of Darwin in the study of evolution. Microscopic study of animal tissues by Theodor Schwann (1810–1882) founded the science of histology and led to the establishment of the cell theory (*see* Cell). The study of embryology, or the development of the individual organism, was founded by von Baer (1792–1876); and at the same time the foundations of animal physiology were laid by Johannes Müller (1801–1858).

Zoölogy up to 1860 was thus the product of the concurrent growth of knowledge in regard to these subjects—the structure of animals (morphology), their development (embryology), and their vital activities (physiology). Then an additional element was introduced which has illuminated the whole field. This was the doctrine of organic evolution, as set forth by Darwin in 1859 (*see* Darwin, Charles Robert; Evolution). From that time to the present the study of zoölogy has been dominated by the idea of evolution, and animals and plants have been studied broadly—in the light of their ancestral history. Progress is dependent still upon advance in anatomy, physiology, and embryology, but the point of view from which the facts are considered has been changed. (*See* Animal Kingdom.)

The study of animal structure or morphology, together with microscopic anatomy (histology) and embryology, makes up what is called structural zoölogy. The general description and classification of animals is systematic zoölogy or taxonomy. The geographical distribution of animals has been widely studied and elevated to the rank of a special department. Standing coördinate with the great field of morphology is physiology, which, broadly speaking, concerns itself with the vital processes of all living organisms. Studies of the mental powers and the mental phenomena in animals lead to animal psychology, which may fairly be considered a part of zoölogy.

—REFERENCE-OUTLINE *for Organized Study of* ZOÖLOGY—

FROM the very beginning, man has had to wage a ceaseless struggle against harmful animals. First he fought the predatory wild beasts; now his strategy is directed mainly towards species that damage crops or intimately affect his health. Of other animals he has made friends and allies, some to furnish food and clothing or the raw materials for many industries, some to provide a means of transportation, and some to assist in the fight against animal foes. But even apart from its practical value, a knowledge of animal life as an end in itself is fascinating and well worth while. Whether or not one has had a previous introduction to zoölogical science, it is advisable for all to make use of the following outline, in which the essentials of zoölogy are crystallized.

Classification of Animals

Phylum **PROTOZOA:** The simplest animals; body of one cell, aquatic, microscopic in size P-357. Examples: Amoeba A-188; Chalk Animals C-137*a;* Malarial Parasite M-266, M-269 picture; Trypanosomes G-78 picture.

Phylum **PORIFERA** ("pore-bearing" animals): This includes all the Sponges S-260.

Phylum **COELENTERATA:** Radially symmetrical animals having a single cavity in the body; all aquatic, mostly marine. Examples: Hydra H-365; Jelly-Fish J-209; Sea-Anemones S-66; Corals C-362.

Phylum **PLATYHELMINTHES** (Flatworms): Some free-living forms but many internal parasites. Examples: Tapeworm W-179; Liver Fluke W-179.

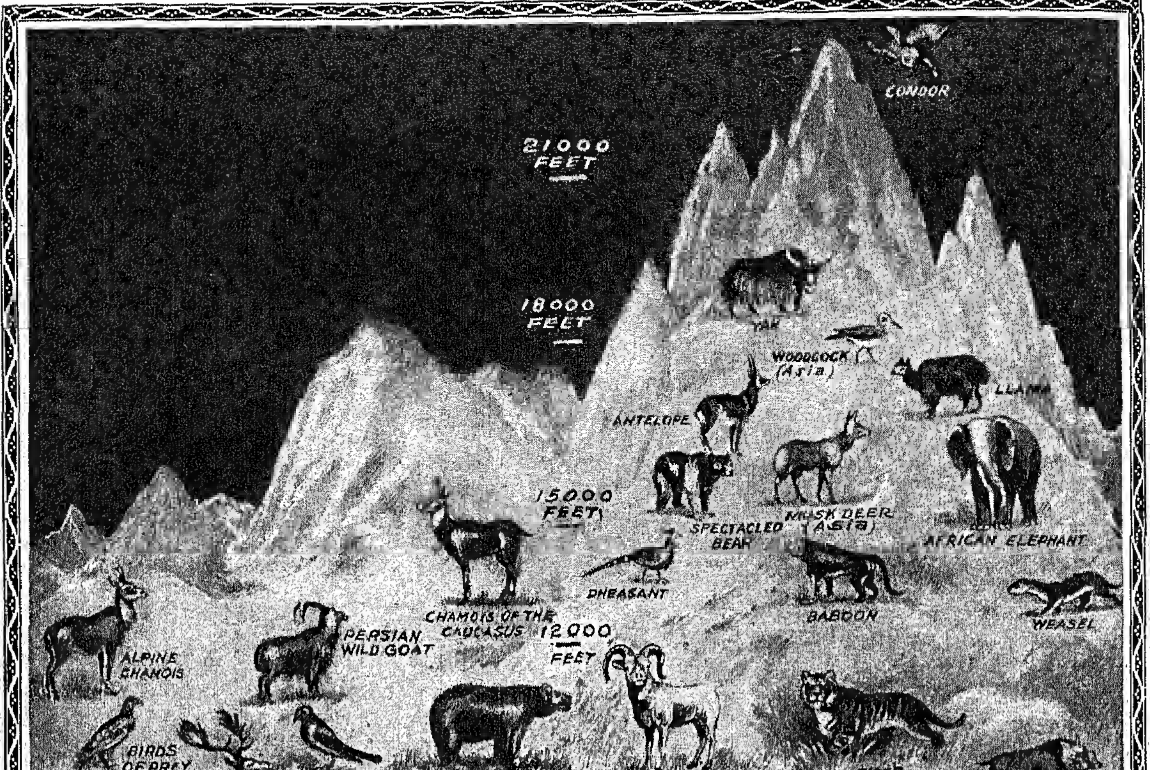
Phylum **NEMATHELMINTHES** (Roundworms): Thread-like worms, cylindrical but not segmented like the worms in Phylum **ANNULATA.** Examples: Hookworm H-333; Trichina W-180; Vinegar Eel W-180.

Phylum **TROCHELMINTHES** (Wheelworms): Rotifera or "wheel animalcules," mostly microscopic W-180.

Phylum **MOLLUSCOIDA:** Includes the Bryozoa, tiny colonial animals (sometimes called "Sea Moss") W-179, and the Brachiopoda or Lamp Shells S-107, S-109, W-180.

Phylum **ECHINODERMATA** ("spiny-skinned" animals): Radially symmetrical, five-parted in structure, all marine. Examples: Starfish S-276; Sea-Urchins and Sand-Dollars S-72, S-277; Sea-Cucumbers S-67.

ALTITUDE RECORDS IN THE ANIMAL WORLD



Biology teaches us that living creatures can adapt themselves to widely different conditions of life, if they are given a chance to acquire new habits slowly from generation to generation. Here we see how various kinds of animals have become accustomed to altitudes ranging from sea level to many thousand feet on the mountain slopes. But you must not imagine that the "higher-ups" have any advantage over the "lower-downs." The Yak of the Tibetan plateau, for instance, could no more get along in the lowland jungle where the Orang-Utan lives, than the Orang-Utan could live in the Yak's lofty home. You will notice that the Condor, that great South American bird, *is given the highest place. This is really an honor he doesn't deserve*, for, while the Condor flies *over* the highest peaks of the Andes, he doesn't really live there, but nests much lower down. The Yak, after all, holds the championship, for in the wild state he is found on mountains in Tibet, where few human visitors could long stand the rarefied air. It may surprise you to find the African Elephant and the Baboon so high up in the world. But remember that it is not nearly so cold at such heights in equatorial Africa as it is on the low frozen shores where the Polar Bear is found. An example of biological adaptation is provided by the Woodcocks. The Asiatic member of the family finds himself comfortable at 17,000 feet, but his European cousin seldom lives above 7,000 feet. While the Cat family as a rule flourishes best in lowland climates, the Siberian Tiger ranges as high as 10,000 feet, doubtless lured there in pursuit of prey which sought to avoid him by fleeing higher. His long soft fur is a better protection against cold than the shorter coat of his Bengal brother.

Phylum **ANNULATA** (**"ringed" animals**): Wormlike animals with segmented bodies. Examples: Earthworms E-136; Leeches L-92.

Phylum **MOLLUSCA**: Unsegmented animals, most of them bearing shells M-218, S-107. Examples: Clams and Mussels C-258; Oysters O-262, P-97; Scallops S-35; Snails and Slugs S-167; Nautilus N-44; Squid and Cuttlefish C-415, S-265; Octopus C-417, O-201.

Phylum **ARTHROPODA** (**"jointed-legged"**): Segmented body, external skeleton, jointed appendages. The largest phylum in the animal kingdom.

- Class **Myriapoda** (**"thousand-legged"**). Examples: Myriapods and Centipedes C-131.
- Class **Crustacea** ("crusty" shells). Examples: Lobsters L-175; Crawfish C-391; Shrimps S-135; Crabs C-388; Barnacles B-47.
- Class **Arachnida** (spider class). Examples: Scorpions S-43; Spiders, Mites, and Ticks S-252.
- Class **Hexapoda** (**"six-legged"**): **The Insects I-81.** The orders of this important class are given on page I-88. Examples: May-Fly M-94; Dragon-Fly D-88; Cockroach C-291; Mantis M-53; Grasshopper G-137, K-7; Cricket C-397; Water-Bug W-46; Cicada C-234; Aphids A-226; Scale Insects S-34; Ant-Lion A-224; Butterflies and Moths B-282, C-98; Fly F-128; Mosquito M-266; Flea F-106; Beetles B-80, W-65; Ichneumon Flies I-6; Wasp W-32; Bee B-73; Ant A-211.

Phylum **CHORDATA**: Animals having a notochord, or internal axial rod, from which the vertebral column develops in higher forms. Primitive Chordates include the Lancelets, Sea-Squirts, Acorn Worm. Higher Chordates, having a true backbone, comprise the Vertebrates V-290, which are divided as follows:

- Class **Cyclostomata**. Examples: Lampreys and Hag Fishes L-56, F-67.
- Class **Pisces**: **The Fishes F-67.** Principal groups are:
  - **a. Cartilaginous Fishes.** Examples: Sharks S-102; Skates and Rays S-154; Torpedo-Fish T-113.
  - **b. Lung-Fishes M-295.**
  - **c. Armored Fishes, or Ganoids F-68, F-73.** Example: Sturgeon S-310.
  - **d. Bony Fishes.** Examples: Herring H-287; Shad S-94; Sardines S-28; Tarpon T-14; Salmon S-13; Trout T-145; Whitefish W-85; Carp C-86, G-115; Catfish C-100; Eel E-191; Stickleback S-289; Sea-Horse S-67; Flying-Fish F-130; Cod C-294; Mackerel M-12; Tunny T-154; Perch P-122; Bass B-63; Sunfish S-330; Swordfish S-359; Flat-fish F-103, F-117.
- Class **Amphibia**. Examples: Frog F-207; Toad T-100; Salamander S-12.
- Class **Reptilia**: **The Reptiles R-78.** Four living orders:
  - Order **Chelonia**: **The Turtles and Tortoises T-166.**
  - Order **Rhynchocephalia**: **The Sphenodon L-172.**
  - Order **Squamata**: **The Lizards L-169 and the Snakes S-169.** Examples: Lizards—Iguana I-11; Chameleon C-137b. Snakes—Boa Constrictor B-160; Python P-374; Cobra C-290; Vipers V-302, C-361.
  - Order **Crocodilia**: **The Alligators A-129; the Crocodiles C-398; the Gavials C-399.**
- Class **Aves**: **The Birds B-120.** The principal orders are given on page B-132. For convenience in this outline, birds may be divided into running birds and flying birds. The latter include two groups of orders—the water birds and the land birds.
  - **a. Running Birds.** Examples: Ostrich O-253; Emu E-263; Cassowary C-92; Kiwi Z-222.
  - **b. Water Birds.** Examples: Penguin P-109; Loon L-196; Albatross A-108; Petrel P-143; Pelican P-103; Gannet G-5; Frigate-Bird F-206; Heron S-294, B-151; Stork S-294; Flamingo F-103; Duck, Goose, and Swan D-116, G-119, S-333; Crane S-294; Rail, Gallinule, and Coot R-35; Plover P-258; Woodcock, Snipe, and Sandpiper W-133, S-173; Gull and Tern G-185; Auk A-364.
  - **c. Land Birds.** Examples: Vulture V-336, B-288, C-328; Secretary Bird S-73; Kite, Hawk, and Eagle K-26, H-245, E-123; Grouse G-179; Quail Q-1; Pheasant, Peacock, and Common Fowl P-157, P-93, P-336; Turkey T-158; Pigeon and Dove P-215; Parrot and Macaw P-82, M-2; Cuckoo C-413; Owl O-256; Nighthawk and Whippoorwill N-144, W-84; Swift S-332; Humming-Bird H-356; Kingfisher K-21; Hornbill H-339; Toucan T-116; Woodpecker W-134; Tyrant Flycatcher F-129, K-21; Lark L-65; Swallow S-332; Jay, Magpie, and Crow B-160, M-36, C-402; Bird of Paradise P-64; Titmouse T-99, C-198; Nuthatch and Creeper N-186; Wren W-181; Mocking-Bird and Thrasher M-212, T-85, C-98; Thrush and Bluebird T-88, B-159, R-118; Nightingale N-144; Kinglet K-22; Pipit T-99; Waxwing W-58; Shrike S-135; Starling S-277; Vireo V-303; Wood Warbler W-7; Meadowlark and Blackbird M-95, B-152, B-166, O-250; Tanager T-8; Grosbeak, Sparrow, and Finch G-178, C-82, S-238, F-35.
- Class **Mammalia**: **The Mammals M-44.**
  - Order **Monotremata**: **Egg-laying mammals.** Examples: Duckbill D-118; Spiny Ant-Eater A-372.
  - Order **Marsupialia**: **Mammals with abdominal pouch for carrying young.** Examples: Kangaroo K-1; Opossum O-235; Tasmanian Devil T-14; Tasmanian Wolf T-15.
  - Order **Edentata** (**"toothless"**). Examples: Sloth S-164; Armadillo A-301; Great Ant-Eater A-217; Pangolin Z-222.
  - Order **Tubulidentata** (**"tube-toothed"**): **The Aardvark A-2.**
  - Order **Cetacea** (**"whale-like"**). Examples: Whale W-77; Dolphin D-86; Porpoise P-306.
  - Order **Sirenia** (**"siren-like"**). Examples: Manatee and Dugong M-49.
  - Order **Artiodactyla**: **Even-toed hoofed animals.** Examples: Pig H-316; Wild Boar B-160; Peccary P-100; Hippopotamus H-293; Camel C-36; Alpaca A-134; Llama L-173; Giraffe G-91; Deer D-35; Caribou C-84; Moose M-257, E-256; Musk Deer M-323; Reindeer R-71; "Elk" or Wapiti W-7, E-256; Antelope A-218; Chamois C-138; Common Cattle C-101; Buffalo B-261; Zebu Z-216; Yak Y-203; Goat G-108, I-1; Bison B-148; Musk Ox M-323.
  - Order **Perissodactyla**: **Odd-toed hoofed animals.** Examples: Horse H-341; Ass A-337; Zebra Z-216; Tapir T-10; Rhinoceros R-94.
  - Order **Proboscidea**: **Hoofed animals with a proboscis.** Examples: Elephant E-244; Mammoth and Mastodon M-44.
  - Order **Hyracoidea**: **The Hyrax or Conies Z-222.**
  - Order **Rodentia** (**"gnawers"**): **The Rodents R-124.** Examples: Squirrel S-265; Chipmunk C-222; Marmot P-342, G-179; Beaver B-70; Pocket Gopher G-120; Dormouse D-87; Muskrat M-324; Rat R-51; Mouse M-293; Porcupine P-305; Guinea-Pig G-184; Chinchilla C-222; Hare and Rabbit H-221.
  - Order **Carnivora** (**"flesh-eaters"**). Examples: Dog D-76; Wolf W-128; Jackal J-177; Fox F-164; Raccoon R-9; Panda Z-222; Bear B-67; Marten M-71; Weasel W-59, E-300, F-26; Mink M-189; Wolverine W-130; Skunk S-157; Badger B-13; Otter O-255; Hyena H-369; Mongoose M-224; Cat C-95; Jaguar J-181; Leopard L-98; Lion L-154; Puma P-365; Tiger T-92; Lynx L-223; Seal S-68; Walrus W-6.
  - Order **Insectivora** (**"insect-eaters"**). Examples: Mole and Shrew M-216; Hedgehog H-269.
  - Order **Chiroptera** (**"hand-winged"**): **The Bat B-63.**

Order Primates ("chief"): Mammals with nails. Examples: Lemur L-94; Monkey M-225; Ape A-225, C-208, G-123, O-240; Man M-45.

Adaptations and Habits

I. ADAPTATIONS OF ANIMALS: A-199, E-145*a*, E-342. The various ways in which organisms are fitted for their different kinds of lives are known as adaptations.

A. Adaptations for Obtaining Food:
- a. **From the Water:** Clam C-258; Hydra H-365; Baleen Whale W-78; Duck D-116 picture.
- b. **From the Air:** Nighthawk N-144; Flycatcher F-129; Dragon-Fly D-88; Spider S-252.
- c. **From the Soil:** Earthworm E-137; Mole M-216; Aardvark A-2.
- d. **Procuring and Grinding Plant Food:** Ruminants R-176; Horse H-341; Elephant E-244.
- e. **Gnawing Plant Food:** Rodents R-124; Chipmunk C-222; Beaver B-70.
- f. **Rasping and Tearing Flesh Food:** Cat C-95; Wolf W-128; Lion L-154.

B. Adaptations for Protection:
- a. **Protective Coloration and Mimicry: P-353.** Birds B-131; Cephalopods M-218; Chameleon C-137*b;* Fish F-70; Flatfish F-104; Giraffe G-92; Grouse G-180; Insects I-84, I-85 pictures; Rabbit H-222; Tiger T-93.
- b. **Offensive and Defensive Armor:** Armadillo A-301; Beetle B-80; Porcupine P-305; Rhinoceros R-94; Turtle T-166.
- c. **Feigning Death:** Opossum O-235; Hog-Nosed Snake S-173.
- d. **Special Means:** Bombardier Beetle I-85, B-82, B-84 picture; Cuttlefish C-415; Skunk S-157; Torpedo-Fish T-113; Wasp W-32.

C. Adaptations for Locomotion:
- a. **Swimming:** Fish F-68; Seal S-68; Shrimp S-135; Whale W-77.
- b. **Running:** Antelope A-218; Hare H-221; Horse H-341; Ostrich O-253.
- c. **Jumping:** Grasshopper G-137; Flea F-106; Jerboa R-51; Kangaroo K-1.
- d. **Burrowing:** Mole Cricket C-397; Gopher G-120; Mole M-216.
- e. **Climbing:** Squirrel S-265; Cat C-95; Monkey M-225; Climbing Perch F-73.
- f. **Flying and Gliding:** Bat B-63; Birds B-120; Flying-Fish F-130; Flying Squirrel S-266; Ballooning Spider S-256.

D. Adaptations for Preservation of Species:
- a. **Producing Large Numbers of Eggs: E-192.** Aphid I-93; Fly F-128; Fish F-71; Frog F-207; Oyster O-262.
- b. **Making Nests:** Alligator A-129; Ant A-213; Bee B-73; Birds B-125, B-127 pictures; Insects I-86; Spiders S-254; Stickleback S-289; Sunfish S-330; Termite A-215 picture; Wasp W-32–5; Weaver-Bird W-62.

II. BEHAVIOR OF ANIMALS:

A. **Instinct and Intelligence: A-202, I-91.** Ape A-225; Beaver B-70; Dog D-76.

B. **Social Habits:** Ant A-211; Bee B-73–8; Wasp W-32.

C. Means of Intercommunication:
- a. **Voice: V-331.**
- b. **Odors: S-164.**
- c. **Stridulation of Insects:** Cicada C-234; Grasshopper G-138; Katydid K-8.
- d. **Language of Bees: B-78 picture.**
- e. **Luminescence: P-176.** Firefly F-58.
- f. **Danger Signals:** Deer D-37.

D. **Hibernation: H-288.** Bear B-67; Frog F-208; Groundhog G-179; Estivation of Mudfish M-296.

E. **Migration: M-163.** Arctic Tern G-185; Bobolink B-166; Crab C-388; Eel E-191; Goose G-120; Locust G-138; Golden Plover P-259; Salmon S-13.

Distribution and Economic Importance

I. DISTRIBUTION OF ANIMALS:

A. **The Six Great Haunts of Life: A-201 picture.**

B. **Life in the Sea: O-195–201, B-114.**

C. **Vertical or Altitudinal Distribution: Z-228 picture.**

D. **Geographical Distribution:** Naturalists have divided the world into six great zoögeographical regions, or life realms, as follows:
- a. **Palearctic Region:** Includes Europe, Asia north of the Himalayas, and Africa north of the Sahara.
- b. **Nearctic Region:** North America north of Mexico.
- c. **Ethiopian Region:** Africa from the Sahara southward, and Madagascar.
- d. **Oriental Region:** India, Ceylon, Siam, southern China, and the Malay Archipelago.
- e. **Neotropical Region:** America from Mexico southward.
- f. **Australian Region:** Australia, Tasmania, New Guinea, New Zealand, Pacific Islands.

Note: *See* Geography outlines for the animals peculiar to each of these regions.

E. **Geologic Distribution: G-40–2.** Fossils F-161; Prehistoric Animals A-204.

II. ECONOMIC IMPORTANCE OF ANIMALS:

A. Animals Indirectly Injurious to Man:
- a. **To Crops and Forests:** Gopher G-120; Groundhog G-179; Hare and Rabbit H-221; Prairie-Dog P-342; Crow C-402; Aphids A-226; Army-Worm A-308; Cankerworm C-72; Chinch Bug C-222; Cicada C-234; Codlin Moth C-294; Cutworm C-418; Grasshopper G-137; Hessian Fly H-287; June Bug J-228; Potato-Bug P-326; Scale Insects S-34; Weevil W-65; Other Insect Pests I-89; Forest Insects F-155.
- b. **To Live Stock and Poultry:** Fox F-165; Lynx L-223; Puma P-365; Weasel W-59; Wolf W-129; Hawk H-245; Bot-Fly F-129; Buffalo Gnat G-108; Mite and Tick S-258; Liver Fluke W-179; Other Internal Parasites P-67.
- c. **To Stored Food:** Mouse M-293; Rat R-51; House Ant A-214; Cockroach C-291; Weevil W-65.
- d. **To Clothing, Books, etc.:** Clothes Moth B-286; Carpet-Beetle B-84; Bookworm B-84; Drug-Store Beetle B-83.
- e. **To Houses, Ships, Wharves, etc.:** Termite A-215; Boring Beetle B-84; Barnacle B-47; Teredo or Shipworm S-107.

B. **Animals Directly Injurious to Man:** Some cause diseases, others transmit diseases; some kill by poisoning; others bite, sting, or annoy. *See* Reference-Outline for **Physiology, Hygiene, and Medicine.**

C. Animals Useful to Man:
- a. **For Food:** Wild animals captured for food include Deer D-35; Antelope A-218; Hare and Rabbit H-221; Pheasant P-157; Quail Q-1; Duck D-116; Frog F-207; Food Fishes F-74; Octopus C-417; Snail S-168; Scallop S-35; Clam and Mussel C-258; Crab C-388; Lobster L-175; Shrimp S-135; Sea-Cucumber S-67. Some animal food products are Honey B-76; Milk M-172; Lard and Tallow F-19; Gelatin G-25; Cod-Liver Oil V-311.

Note: Domestic animals used for food are treated in the Reference-Outline for **Agriculture.**
- b. **For Transportation:** Ass A-337; Water-Buffalo B-261; Camel C-36; Dog D-76; Elephant E-244; Horse and Mule H-341; Llama L-173; Ox C-101; Reindeer R-71; Yak Y-203; Zebu Z-216.
- c. **Commercial Products of Animals:** Alpaca A-134; Ambergris W-80; Beeswax B-76; Bone B-172; Bristles H-196; Cochineal C-291, I-79; Coral C-362; Feathers F-20, O-253, D-118; Fertilizer F-27; Furs F-223; Glue G-107; Glycerin G-108; Horn H-338; Isinglass I-152, G-25; Ivory I-175; Leather L-83; Mohair G-108; Mother-of-Pearl S-107, S-108; Musk M-323, C-399; Parchment P-57; Pearl P-97;

Sepia I-79; Shell S-106; Shellac L-52; Silk S-144, S-257; Spermaceti W-80; Sponges S-260; Tyrian Purple D-121; Whalebone W-78; Wool W-140.

d. As Destroyers of Pests: Badger B-13; Bat B-63; Mole M-216; Skunk S-157; Birds, general B-121–2; Hawk H-245; Owl O-256; Gambusia Minnow M-270; Frog, F-208; Toad T-100; Snake S-172; Insects, general I-81–93; Calosoma Beetle B-82 picture; Dragon-Fly D-88; Ichneumon Fly I-6; Lacewing and Hover Fly I-91–3; Lady-Bug L-53, S-34; Wasp W-35.

e. As Pollenizers of Plants: I-88, F-31, C-281. Bee B-76–7; Humming-Bird H-356; Fig-Wasp F-31.

f. As Scavengers: Insects B-83, I-88, I-83 picture; Buzzard B-288; Vulture V-336; Gulls G-186.

g. As Land Builders and Tillers of the Soil: Coral C-362; Foraminifera P-357; Earthworm E-137.

Bibliography for Zoölogy

—Books for Younger Readers:

Beard, D. C. American Boys' Book of Bugs, Butterflies, and Beetles (Lippincott, 1932).
Beebe, William. Exploring with Beebe (Putnam, 1932).
Bronson, W. S. Wonder World of Ants (Harcourt, 1937).
Ditmars, R. L. Book of Living Reptiles (Lippincott, 1936).
Ditmars, R. L. Book of Zoögraphy (Lippincott, 1934).
Eifrig, C. W. G. Mammals (Rand, 1928).
Eifrig, C. W. G. Reptiles, Amphibians, and Fishes (Rand, 1930).
Emans, E. V. About Spiders (Dutton, 1940).
Henderson, D. M. Children of the Tide (Appleton-Century, 1926).
Hoogstraal, Harry. Insects and Their Stories (Crowell, 1941).
Hornaday, W. T. Tales from Nature's Wonderlands (Scribner, 1924).
Johnson, Gaylord. How Father Time Changes the Animals' Shapes (Messner, 1939).
McCreery, J. L. Exploring the Earth and Its Life (Stokes, 1940).
Maeterlinck, Maurice. Children's Life of the Bee (Dodd, 1919).
Morgan, Alfred. Aquarium Book for Boys and Girls (Scribner, 1936).
Reed, W. M. and Lucas, J. M. Animals on the March (Harcourt, 1934).
Robinson, W. W. Animals in the Sun (Harper, 1934).
Sanderson, I. T. Animals Nobody Knows (Viking, 1940).
Seton, E. T. Wild Animals I Have Known (Scribner).
Snedigar, Robert. Our Small Native Animals (Random, 1939).
Verrill, A. H. Strange Sea Shells and Their Stories (Page, 1936).

—Books for Advanced Students and Teachers:

Anthony, H. E. Fieldbook of North American Mammals (Putnam, 1928).
Beebe, William. Zaca Venture (Harcourt, 1938).
Bostock, F. C. Training of Wild Animals (Appleton-Century, 1903).
Boulenger, E. G. World Natural History (Scribner, 1938).
Breder, C. M. Field Book of Marine Fishes of the Atlantic Coast (Putnam, 1929).
Buchsbaum, R. M. Animals without Backbones (Univ. of Chicago Press, 1938).
Chapman, R. N. Animal Ecology (McGraw, 1931).
Comstock, J. H. The Spider Book (Doubleday, 1940).
Curtis, W. C. and Guthrie, M. J. Textbook of General Zoölogy (Wiley, 1933).
Dickerson, M. C. Frog Book (Doubleday, 1906).
Ditmars, R. L. Fight to Live (Stokes, 1938).
Hamilton, W. J. American Mammals (McGraw, 1939).
Hegner, R. W. College Zoölogy (Macmillan, 1936).
Hegner, R. W. and Jane. Parade of the Animal Kingdom (Macmillan, 1935).
Herrick, G. W. Insect Enemies of Shade-Trees (Comstock, 1935).
Hogben, L. T. Principles of Animal Biology (Norton, 1940).
Holland, W. J. Butterfly Book (Doubleday, 1931).
Hornaday, W. T. American Natural History (Scribner, 1935).
Hornaday, W. T. Taxidermy and Zoölogical Collecting (Scribner, 1929).
Huxley, J. S. Ants (P. Smith, 1930).
Innes, W. T. Complete Aquarium Book (Blue Ribbon, 1936).
Kearney, P. W. Strange Fishes and Their Strange Neighbors (Doubleday, 1933).
Kearton, Cherry. Island of Penguins (McBride, 1931).
Lutz, F. E. Field Book of Insects (Putnam, 1935).
Morgan, A. H. Field Book of Animals in Winter (Putnam, 1939).
Morris, P. A. What Shell Is That? (Appleton-Century, 1939).
National Geographic Society. Book of Fishes (The Society, 1939).
Nelson, E. W. Wild Animals of North America (Nat. Geog. Soc., 1930).
Newman, H. H. Outlines of General Zoölogy (Macmillan, 1936).
Noble, G. K. Biology of the Amphibia (McGraw, 1931).
Parker, T. J. and Haswell, W. A. Textbook of Zoölogy, 2v. (Macmillan, 1930).
Peairs, L. M. Insect Pests of Farm, Garden, and Orchard (Wiley, 1941).
Pickwell, G. B. Animals in Action (McGraw, 1940).
Pope, C. H. Snakes Alive and How They Live (Viking, 1937).
Pope, C. H. Turtles of the United States and Canada (Knopf, 1939).
Pratt, H. S. Manual of Land and Fresh Water Vertebrate Animals of the United States (Blakiston, 1923).
Pratt, H. S. Manual of the Common Invertebrate Animals (Blakiston, 1935).
Sanderson, I. T. Animal Treasure (Viking, 1937).
Seton, E. T. Lives of Game Animals, 8v. (Doubleday, 1925–28).
Shull, A. F. and others. Principles of Animal Biology (McGraw, 1934).
Teale, E. W. The Golden Throng (Dodd, 1940).
Thomson, J. A. New Natural History, 3v. (Putnam, 1926).
Verrill, A. H. Wonder Creatures of the Sea (Appleton-Century, 1940).
Washburn, F. L. Injurious Insects and Useful Birds (Lippincott, 1918).
Wheeler, W. M. Social Life among the Insects (Harcourt, 1923).
Wolcott, R. H. Animal Biology (McGraw, 1933).
Writers' Program, New York City. American Wild Life (Wise, 1940).
(*See also* bibliographies for Birds and Nature Study.)

ZOROASTER. Far back in the misty past, perhaps a thousand years before the birth of Christ, when the ancestors of the Medes and the Persians were still a wandering shepherd people, a wise man named Zoroaster (also called Zarathustra) founded a new religion. By the flame of his genius he so transfused the old folk-legends and ceremonies of the ancient Iranians that from them emerged one of the noblest of the ancient religions. Called Zoroastrianism after its founder, this faith spread until, when the Persian Empire was at its height, it was held by most of the inhabitants of western Asia and Asia Minor. Its followers have since dwindled until now they number only about 100,000, chiefly in India, where they are known as Parsees.

Seeing the ceaseless struggle going on in the world, Zoroaster thought of life as a battle, in which the forces of storm and sunshine, of good and evil, were struggling for the mastery. At the head of the forces of good he placed Ahura Mazda or Ormuzd, representing light, life, health and strength, truth, and all that is good. Ahriman represented darkness, the destructive forces of nature, death, deceit, evil of all kinds, like the Satan of the Hebrew and Christian religions. Ahura Mazda was aided by holy spirits or angels; while on the side of Ahriman were ranged evil demons. In the end Ahura Mazda would triumph; but every man, Zoroaster taught, must fight on one side or the other, and he will receive reward or punishment hereafter according to his choice.

Zoroastrianism was the first universal religion, as opposed to the purely national or tribal faiths of Egypt and the ancient Jews. From the start it aimed at converting men of all races, and thus became the first creed to work by missions. Fire, the purest of the elements and the symbol of the spirit, played an important part in its worship, though the followers of the pure religion, at least, were not really "Fire Worshipers," as they have sometimes been termed. Their doctrines and teachings, as embodied in their sacred

book called the Avesta or Zend-Avesta, show that their ideal of religious and moral life was a high one. It is summed up in the words, "good thoughts, good words, good deeds."

The *magi* were the priestly and learned caste of the ancient Persians. Zoroaster laid down rigorous rules to govern their life, which was to be simple and severe. But in the course of the centuries they fell from their high position, becoming mere strolling jugglers and soothsayers. It is from the black arts they were supposed to practise that we get our word "magic." The name survived until the Christian Era to designate learned men, especially astronomers. The New Testament tells how three magi, or wise men of the East, came to worship at the manger where the infant Jesus lay.

After the time of Alexander the Great, Zoroastrianism gradually declined. It received its deathblow in the middle of the 7th century with the Mohammedan invasion, though it still survives in a few remote districts of Persia and among the Parsees of India.

ZURICH (*zu'rik*), SWITZERLAND. The largest city of Switzerland, Zurich is also the Swiss center of banking and industry. It has developed into a modern metropolis without losing its historic charm. It lies on Lake Zurich in the cradle of the northern Swiss plateau, within view of the Alps and the Jura. From the lake the swift icy waters of the River Limmat flow through the city.

On this site stood the huts of lake dwellers many thousands of years ago. Here, in the first century of our era, the Roman conquerors built a town called Turicum. In the early Middle Ages, Zurich prospered under Charlemagne's protection, and in 1218 was declared a free town of the Holy Roman Empire.

Even before joining the Swiss Confederation in 1353, Zurich was noted for its building and other trades. Great churches began to rise. Two of these, the Gross Münster (built between the 11th and the 13th centuries) and the Frau Münster (13th–15th centuries), look out serenely today over stores, banks, factories, and the busiest streets in all Switzerland. It was at the Gross Münster that Zwingli launched his Protestant reforms (*see* Zwingli).

It was in Zurich that Johann Pestalozzi at the end of the 18th century conceived ideas which have revolutionized methods of teaching (*see* Education). Two of the city's best-known educational institutions are the University of Zurich (founded 1832) and the Federal Polytechnic School (founded 1855). The Central Library contains letters of Luther, Zwingli, Calvin, Henry IV of France, Frederick the Great, and many other celebrities. Priceless treasures of art draw throngs of visitors to the Swiss National Museum.

Ancient trade routes converging at Zurich have been transformed into railroads that bring into the city many raw materials for manufacture. The factories have grown so huge that the near-by homes of workers are numbered in thousands. The chief products are textiles and machinery, largely for export. The textiles are cotton, silk, and rayon. The machinery is for use in textile and electrical industries. Other manufactures are books and paper.

Zurich has long been a refuge for political and religious exiles. Tourists seek out the city for its beauty and climate. Nearly all the residents are of German descent; a few thousands trace their ancestry to Italy or France.

Since 1353 Zurich has served at various times as capital of the entire Swiss Confederation, but yielded this honor in 1848 to the more nearly central city of Bern (*see* Bern). Today Zurich is capital only of the canton of Zurich, which has an area of 668 square miles and a population of some 620,000. Population of city, about 320,000.

ZWINGLI (*tsving' lĭ*), ULRICH (1484–1531). The Protestant Reformation, which came to Germany through Luther, was brought to Switzerland by Ulrich Zwingli. Although Zwingli's influence on the Protestant movement was not so great as Luther's, he made an important contribution to Protestant doctrine.

The son of a prosperous Swiss farmer, he received a good education at Swiss schools and at the University of Vienna. In 1516 he was appointed priest at the shrine of Einsiedeln, and there, studying Erasmus' edition of the New Testament, he began to preach a direct interpretation of the gospel and to attack abuses in the Catholic church.

In 1518 he was appointed preacher at the cathedral of Zurich, where, under the influence of Luther, he broke completely with the papacy. When Pope Adrian VI asked the people of Zurich to abandon Zwingli, the town council held a public debate in which Zwingli defended his views so ably that the canton decided to uphold the reformer and to withdraw from the church. Although other cantons followed Zurich, the five "forest cantons" remained zealously Catholic.

Zwingli's belief in the supreme authority of the Bible caused him to diverge from Luther on many points of doctrine. Furthermore, Zwingli, who was a political as well as a religious reformer, supported the Peasants' Revolt, while Luther opposed it.

Zwingli was slain in the battle of Kappel fought between the Catholic and Protestant cantons of Switzerland. A great boulder, standing a little way off the road, marks the place where he fell. It is inscribed, "'They may kill the body but not the soul': so spoke on this spot Ulrich Zwingli, who for truth and the freedom of the Christian Church died a hero's death, Oct. 11, 1531."

THE EASY REFERENCE FACT-INDEX

GUIDE TO ALL VOLUMES FOR SUBJECTS BEGINNING WITH

W-X-Y-Z

TO SAVE TIME

USE THIS INDEX ☞

EDITOR'S NOTE ON NEXT PAGE TELLS WHY

SPECIAL LISTS AND TABLES

Numerous other lists and tables in the fields of geography, history, literature, science, mathematics, and other departments of knowledge will be found with their appropriate articles in the main text

EDITOR'S NOTE

EVERY user of Compton's Pictured Encyclopedia should form the habit of *first* turning to the Fact-Index section at the end of each volume when in search of specific information. This index is a miniature work of reference in itself and will often give you directly the facts, dates, or definitions you seek. Even when you want full treatment of a subject, you will usually save time by finding in the index the exact page numbers for the desired material.

All page numbers are preceded by a letter of the alphabet, as A-23. The letter indicates the volume. If two or three page numbers are given for the topic you are seeking, the first indicates the more general and important treatment; the second and third point to additional information on other pages. Where necessary, subheadings follow the entry and tell you by guide words or phrases where the various aspects of the subject are treated.

The arrangement of subheadings is alphabetical, except in major historical and biographical entries. In these the chronological order is followed.

The pictures illustrating a specific subject as a rule appear on the same pages as the text to which you are referred. But often illustrations placed elsewhere will prove of additional interest and value. These are indicated by the word *picture* followed by a page number.

A picture reference is frequently intended to call attention to details in the text under the illustration as well as to the illustration itself. This picture-text, therefore, should always be carefully read.

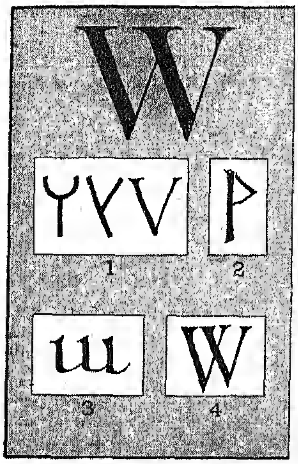
The pronunciations given are those preferred by the best and most recent authorities; alternative pronunciations are indicated only where usage is equally divided. For foreign names the native pronunciation is given except where the English pronunciation has become thoroughly established, as in "Paris," "Barcelona," "Seine."

In recent years hundreds of foreign geographical names have been changed, either officially or by custom. Both old and new names are given at the appropriate places in the alphabet.

Populations are given in round numbers, except for places in the United States and Canada, where the figures are those of the latest official census. Distances between points are map or air distances, not distances by railroad.

THE EASY REFERENCE FACT-INDEX

Reg. U. S. Pat. Off.



The history of our letter W is very short, because the letter did not come into existence until after the Norman conquest of England in 1066. Until then, both 'v' and 'w' were indicated by much the same letter in Semitic, western Greek, and Latin (1), as told in the Fact-Index article on V. This was not as confusing as it might seem, because the sounds of 'v' and 'w' are much alike. This can be proved by pronouncing first 'vee' and then 'we'.

In early medieval times, however, the Anglo-Saxon runic writing developed a separate character (2) for the sound of 'w' as in 'we'. The Anglo-Saxons called the letter *wen*. After the Normans conquered England, they needed such a character for Anglo-Saxon words; but they had developed the practise of using two 'u's' (3) for this sound. They continued this, and gradually linked together two of the old pointed capital letters (4) for the new character. Thus English gained the letter W. We still indicate how the Normans invented the letter by our name for it—'double U'.

Note.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Waal (*väl*) **River**, in Netherlands, the s. arm of the Rhine, *map* B-87

Waals (*väls*), **Johannes Diderik van der** (1837–1923), Dutch physiologist, born at Leyden; Nobel prize for physics 1910; developed laws of fluids and gases; developed formula for computing, from the kinetic theory, whether under given conditions various kinds of matter will be liquid or gaseous, and what conditions are necessary to produce changes of state.

Wabash (*wa'băsh*), Ind., industrial city on Wabash River 80 mi. n. of Indianapolis; pop. 9658; furniture, meters, rubber products, asbestos brake linings, insulation, boxes.

Wabash College, at Crawfordsville, Ind.; for men; founded 1832 by Presbyterians; liberal arts.

Wabash River, Ohio River tributary rising in w. Ohio; forms part of Illinois-Indiana boundary; 475 mi. long: I-46, *maps* I-46, U-188c
early commerce I-47

WAC (Women's Army Corps) N-12*j*

'Wacht am Rhein, Die' ('The Watch on the Rhine'), German national song written by Max Schneckenburger (1819–49) when Rhine was imperiled by France in 1840; music by Karl Wilhelm (1815–73).

Wacker Drive, Chicago C-191

Waco (*wā'kō*), Tex., city in center, 85 mi. s. of Dallas; pop. 55,982; trade in cotton, grain, live stock; cotton products, men's clothing, tents and awnings, flour; Baylor University; Paul Quinn College (for Negroes): *map* T-58

Wadai (*wä-dī'*), formerly independent sultanate, s. of Sahara and e. of Lake Tchad; now part of Tchad colony, French Equatorial Africa; 80,000 sq. mi.; pop. more than 450,000; chief town Abeshr.

Waddell, Hugh, North Carolina leader N-159

Wade, Benjamin Franklin (1800–78), American statesman born West Springfield, Mass.; U. S. senator from Ohio 1851–69; bitter antislavery leader and critic of Lincoln's and Johnson's mild reconstruction policies; as president *pro tempore* of Senate would have become president of U. S. if Johnson had been removed: J-223

Wadham College, Oxford O-260

Wadi (*wäd'ĭ*), or **wady**, dry river bed of Sahara S-4

Wading birds, list, *Outline* N-42

Wafd, member of nationalist party in Egypt E-201

WAFS. *See in Index* Women's Auxiliary Ferrying Squadron

Waganda, or **Baganda**, African tribe E-139

Wage and Hour Division, of U.S. Department of Labor U-230

Wages, in economics E-150
China C-221c
index numbers of prices and G-136*h–j*, *graph* G-136*j*
Japan J-188*b*
machine age influence L-93*a*, *b*
minimum F-2, L-44*d*: Henry Ford F-153
tariff protects, in U. S. T-13*a*
trade union movement L-44
World War, 2d N-12*j*, *p–q*, 12*r*–13

Wages and hours law, U. S., popular name of Fair Labor Standards Act of 1938 L-44*d*, C-205, S-334

Wagner (*väg-nĕr'*), **Charles** (1852–1918), French pastor and author ('The Simple Life').

Wagner (*väg'nĕr*), **Cosima** (1837–1930), daughter of Liszt and 2d wife of Richard Wagner; created annual Wagnerian festival at Bayreuth and with son Siegfried directed it after Wagner's death.

Wagner, Honus ("Hans") (born 1874), often rated as the greatest shortstop in baseball history; played for Pittsburgh 1900–17, scoring more runs, hits, and stolen bases than any other player in his league: *picture* B-56

Wagner, Siegfried (1869–1930), German composer and conductor, son of Richard Wagner; directed Wagner Festival Playhouse at Bayreuth and put it on sound basis.

Wagner, Wilhelm Richard (1813–83), German composer W-1, O-228–9
'Das Rheingold', story O-232
'Der Ring des Nibelungen' O-232, N-140
'Die Meistersinger von Nürnberg', story O-232
'Die Walküre', story O-232–3
'Götterdämmerung', story O-233
Liszt befriends L-156
'Lohengrin' L-181: story O-230–1
music drama M-314
quoted on Beethoven B-80
'Siegfried' S-140–1: story O-233
'Tannhäuser' T-9: story O-233
'Tristan und Isolde', story O-234

Wagner-Connery Labor Relations Act L-44*c*, *d*, R-146*j*

Wagner-Jauregg (*väg'nĕr-you'rĕg*), **Julius** (1857–1940), Austrian physician noted for important work in fever therapy A-379

Wagner Memorial Lutheran College, at Staten Island, N.Y.; founded 1883; arts and sciences.

Wagons, carriages, and carts, *pictures* T-123
American colonies T-122–4: handmade cart, *picture* A-168
calèche, or calash, *picture* T-123
chariot: Egyptian W-84*b*, *pictures* E-207, P-14; Roman W-84*b*, *pictures* R-128, T-123, E-335; Sumerian, *picture* T-121
coach, *pictures* T-122, 123
covered wagon, or prairie schooner, and Conestoga wagon T-124, F-16, P-221*g–h*, *pictures* C-32, C-61, F-13, P-221*h*, T-123, U-187
dog cart, Belgium, *picture* B-88
donkey cart: Cairo, *picture* C-15; Ireland, *picture* I-124
Filipino's auto, *picture* P-165
Irish jaunting car, *picture* I-125
Manchurian cart, *picture* M-51
oldest wheeled vehicle, *picture* T-121
ox-cart: American colonies T-124; Armenia, *picture* A-302; California, *picture* S-223; Costa Rica, *picture* C-374; Spain, *picture* S-231*b*; Trinidad, *picture* W-72*d*
rickshaw, or jinriksha, *picture* T-123: Africa, *pictures* A-35, 41
Rome, modern cart, *picture* R-142
royal coach, England, *picture* G-53
Russian peasant cart, *picture* R-180
stage-coach: England R-111; United States T-124, *picture* T-123
stage-wagon T-124
wheelbarrow: Chinese taxi-barrow, *pictures* C-78, C-216; with sail *picture* T-123
wheels invented W-84*a–b*, T-121, *pictures* T-123

Wagram (*vä'grăm*), Germany, village near Vienna where Napoleon defeated Austrians (1809) N-10

Wagtail, common name of a group of Old World passerine birds belonging with the pipits to the family *Motacillidae*; named from their habit of wagging the tail.

SOME OF THE GREAT WARS OF HISTORY

American Revolution (1775–83): Successful revolt of the Thirteen English Colonies in America against British rule; Bunker Hill, Saratoga, Yorktown; independence recognized by Great Britain.

Austrian Succession (1741–48): Concerted action of continental powers to appropriate desirable pieces of Hapsburg lands from Maria Theresa, whose cause was championed by Great Britain; waged between Austria and its allies on one side and France and its allies on the other; war ended with mutual restoration of conquests, except Silesia, which was retained by Prussia. In America called King George's War in which English fought the French.

Austro-Prussian (1866): "Seven Weeks' War," arising out of differences over Schleswig-Holstein question; resulted in overwhelming defeat of Austria at Sadowa, and subsequent exclusion from German federation.

Balkan Wars (1912–13): Attempt of Balkan allies to expel Turkey from Europe; remarkable successes were minimized by subsequent quarrels between allies over newly won territory, enabling Turkey to retain its hold on Constantinople and surrounding territory.

Boer War (1899–1902): Spirited, but futile resistance of Boer settlers in South Africa to extension of British claims; Transvaal and Orange Free State made British colonies.

Chinese-Japanese War (1894–95): Occasioned by rival pretensions in Korea; a complete victory of Japan's modern military machine over China's antiquated forces; Japan forced by European powers to restore all conquests except Formosa.

Civil War in England (1642–49): Struggle between the Crown and Puritan Parliament over distribution of ecclesiastical and civil jurisdiction; Marston Moor and Naseby; execution of Charles I and establishment of commonwealth.

Civil War in the United States (1861–65): Between Union government and Southern Confederacy over latter's attempt to secede from Union; Vicksburg, Gettysburg; Union preserved.

Crimean (1853–56): Undertaken by Great Britain with aid of other powers in defense of Turkey against Russian aggressions; siege of Sebastopol; Turkey left intact.

Crusades (1096–1291): Romantic military expeditions of western princes and prelates to recover Holy Sepulchre from Saracens; capture of Antioch, Jerusalem, and Acre; later Crusades were diverted to other ends and Holy Land lapsed into Mohammedan control.

Dutch Independence (1568–1648): Led by William of Orange; Dutch threw off oppressive Spanish rule and established independent government; siege of Leyden.

Franco-Prussian (1870–71): Clash between Prussia's imperialistic aspirations and the jealousy of Napoleon III, resulting in humiliating defeat of France, downfall of the Second Empire, and proclamation of German Empire; Sedan, siege of Paris.

French Revolution (1792–99): Great Britain headed coalition of Prussia, Austria, and other countries against France in contest that was last phase of long wars between England and France for colonial and maritime supremacy and also clash between two political systems; Valmy, Italian campaign; peace made with all allies except England; Egyptian expedition.

Great Northern (1700–21): Undertaken by Russia aided by Denmark and Poland to secure Baltic port at expense of Sweden; siege of Narva, Poltava; Russia secured provinces about Gulf of Finland and Sweden sank to second-rate power.

Greek Independence (1821–29): Greeks threw off Turkish yoke and revived national independence.

Hundred Years' (1337–1453): Series of conflicts between rulers of France and England over disputed titles to French throne and territories; Crécy, Poitiers, Agincourt, Orléans; England lost French possessions except Calais; French monarchy firmly established.

Mexican (1846–48): Arose from annexation by the United States of former Mexican territory of Texas and ensuing boundary disputes; resulted in complete American victory, establishment of the Rio Grande as the boundary, and cession of upper California and New Mexico to United States.

Napoleonic (1799–1815): Determined resistance of Allied European powers to aggressions of Napoleon, ending in his downfall; Austerlitz, Leipzig, Trafalgar, Waterloo.

Peloponnesian (431–404 B.C.): Between rival states of Athens and Sparta for economic and political control of Greece; Athenian expedition to Syracuse, Aegospotami; Athenian supremacy ended.

Persian (493–479 B.C.): Expeditions of Persian emperors against Greece to punish Athens for aiding revolting Persian colonies in Asia Minor, and to extend empire; Marathon, Thermopylae, Salamis, Plataea; Greece maintained independence and control of Aegean.

Punic Wars (264–241, 218–202, 149–146 B.C.): Death struggle of Rome and Carthage for domination of Mediterranean world; Hannibal's invasion of Italy, Cannae, Zama, Metaurus; Carthago taken and destroyed.

Russo-Japanese (1904–05): Blow dealt by Japan to Russian aggression in Far East; siege of Port Arthur, battle of the Sea of Japan; Japanese interests in Korea recognized as paramount, and Japan established as a first-rate power.

Russo-Turkish (1877–78): Arose indirectly from complicated Balkan situation, and directly from Mohammedan uprising against Balkan Christians; fall of Plevna; power of Turkey in Europe practically destroyed, only to be resuscitated by Congress of Berlin.

Seven Years' (1756–63): Resulted from alliance formed against rapidly expanding Prussia by Austria, Russia, France, and other powers; Great Britain allied with Prussia; Rossbach, Leuthen, Quebec; Prussia established as great nation, and foundation of British Empire laid. France expelled from North America by Great Britain. Called French and Indian War in America.

Spanish-American (1898): Outcome of American sympathy for Cuban revolutionists; established Cuban independence and practically ended Spain's colonial empire, remnants of which were ceded to United States; Manila Bay and Santiago.

Spanish Civil War (1936–39): Successful revolt by Spanish fascists supported by Italy and Germany against the government of the Spanish Republic; victory of the "Popular Front" parties in 1936 elections inspired the revolt.

Spanish Succession (1701–13): Attempt of England, Austria, and allies to prevent establishment of a French prince on Spanish throne; Blenheim; Bourbon House established in Spain, but Austria and England gained extensive French and Spanish possessions. Called Queen Anne's War in America.

Thirty Years' (1618–48): Struggle between Catholics and Protestants of Germany in which Gustavus Adolphus of Sweden played a brilliant part; Leipzig, Lützen; religious and territorial differences settled at price of utter devastation of Germany.

Trojan (c. 1100 B.C.): Waged by Greek princes against King Priam to avenge abduction of Helen, wife of Menelaus of Sparta (myth.); siege and fall of Troy.

Wars of Alexander the Great (334–323 B.C.): Persian Empire completely overthrown in battles of Granicus, Issus, and Arbela; conquest of Syria, Palestine, and Egypt; invasion of Media.

Wars of the Roses (1455–85): Waged by Houses of Lancaster and York, rival claimants to English throne, until royal marriage united the two lines; Bosworth Field.

War of 1812 (1812–14): Between United States and Great Britain, caused by Great Britain's claims to right of search of American vessels on high seas and impressment of seamen; treaty adjusted boundaries, etc., leaving main cause of war unmentioned.

World War (1914–18): A world-wide struggle between Central Powers and Allied and Associated Powers, arising indirectly from clash between two rival systems of commercial imperialism, and directly from diplomatic tangle following murder of Archduke of Austria by a Serb; Central Powers crushed.

SOME FAMOUS WATERFALLS

Noted for Height

	FEET
Angel, Venezuela	3300
Ribbon Falls, Yosemite	1612
King George VI, British Guiana	1600
Roraima, British Guiana	1500
Upper Yosemite	1430
Gavarnie, Pyrenees	1385
Takkakaw, British Columbia	1200
Widow's Tears, Yosemite	1170
Staubbach, Switzerland	980

Noted for Volume and Height

	FEET
Kaieteur, British Guiana	740
Victoria Falls, South Africa (av.)	343
Iguassú, Brazil-Argentina	215
Niagara Falls	167

in science; taught biology for a few years before turning to journalism in 1893 ('The Time Machine'; 'New Worlds for Old'; 'Tono-Bungay'; 'Mr. Britling Sees It Through'; 'Outline of History': *picture* E-289
work characterized E-287-8, N-182-3

Wells, Horace (1815-48), American dentist, early user of anesthetics A-196

Wells, England, city 18 mi. s.w. of Bath; famous 13th century cathedral; important Saxon town; made bishop's see in 905.

Wells College, at Aurora, N. Y.; women; non-sectarian; founded 1868; arts and science.

'Well-Tempered Clavichord, The', famous set of compositions by J. S. Bach: M-311-12

Welsbach (*vĕls'bäχ*), **Karl Auer von** (1858-1929), Austrian chemist and inventor, discoverer of praseodymium and neodymium; inventor of Welsbach light and osmium incandescent electric light.

Welsbach gas mantle G-23

Welsh language (in Welsh Cymraeg) W-3

Welsh terrier D-83

Welt, a strip of material or cord sewed or fastened to a seam to strengthen or decorate it
seam in sewing, *diagram* S-91
shoe, making S-132

Wembley, England, urban district near London; Wembley Park was site of British Empire Exposition 1924-25.

Wenat'chee, Wash., city at junction of Columbia and Wenatchee rivers, 95 mi. s.e. of Seattle; pop. 11,020; large shipping plant for apples; wheat, fruit, lumber, flour, orchard appliances: *map* W-29

Wenceslaus (*vĕn'sĕs-lous*). *See in Index* Wenzel

Wenchow, China, port on e. coast, 225 mi s. of Shanghai; pop. 600,000; formerly important in tea trade: *map* C-212

Wends, name given by Germans to a branch of the Slavic race occupying parts of Saxony and Prussia S-162

Wener (*vā'nẽr*), **Lake,** also **Wenner** and **Vänern,** Sweden, largest lake in Scandinavian Peninsula and 3d largest in Europe; 2149 sq. mi.: *map* N-173
Göta Canal S-337

Wentworth, John (1815-88), journalist, born Sandwich, N.H.; removed to Chicago 1836 and was active in early development of city; editor of *Democrat* 25 years; elected mayor of Chicago 1857 and 1860.

Wentworth, Thomas, Earl of Strafford. *See in Index* Strafford

Wenzel (*vĕnt'sĕl*), or **Wenceslaus,** (1361-1419), king of Bohemia and Holy Roman emperor; attempt to settle Great Schism antagonized archbishop of Mainz, who persuaded the Imperial electors to depose him.

Werfel (*vĕr'fl*), **Franz** (born 1890), Austrian writer, born Prague; came to U.S. 1940; his poetry ranks among best in modern German literature; his novels and dramas notable for their strength and originality ('The Goat Song', play; 'Forty Days of Musa Dagh', 'Song of Bernadette', novels).

Wergeland (*vĕr'gẹ-länd*), **Henrik** (1808-45), Norwegian poet; early erratic verse satirized by Welhaven; hailed by people as prophet of independence; popularity with masses waned after he became great lyric poet ('Jan van Huysums Blomerstykke'; 'Svalen').

Wergeld (*wẽr'gĕld*), or **wergild,** in Anglo-Saxon and Teutonic law N-169

Werner (*vĕr'nẽr*), **Alfred** (1866-1919), French-Swiss chemist; Nobel prize winner in 1913; evolved coördination theory of valency in 1893, to explain how molecules having all valencies satisfied could still unite chemically.

Werner (*wẽr'nẽr*), **M(orris) R(obert)** (born 1897), American biographer, born in New York City ('Barnum'; 'Brigham Young'; 'Tammany Hall'; 'Bryan'; 'Orderly').

Werner (*vĕr'nẽr*), **Zacharias** (1768-1823), German romantic dramatist; 'Martin Luther', 'Der 24 Februar', his best plays, are typical of the lurid "fate tragedy"; in 1814 he became a Catholic priest and was famous for impassioned preaching.

Werrenrath (*wẽr'rĕn-räth*), **Reinald** (born 1883), popular concert baritone, born Brooklyn, N. Y.

Wertheimer (*vĕr'tī-mẽr*), **Max** (1880-1943), psychologist, founder of Gestalt school; contributions to psychology: P-362

Werther (*vĕr'tẽr*), hero of Goethe's romance, 'Die Leiden des jungen Werthers' (The Sorrows of Werther), who suffers intensely because of unrequited love and finally commits suicide.

Werwolf (*wẽr'wulf*), or **werewolf,** a person thought to be transformed into a wolf; belief in wer (or man) animals common in Middle Ages.

Wescott, Glenway (born 1901), novelist, born Kewaskum, Wis.; came to attention with 'The Grandmothers', Harper prize-winning novel of 1927-28 ('Good-bye Wisconsin'; 'The Apple of the Eye').

Weser (*vā'zẽr*), river of Germany rising in s. Hanover; flows n. 280 mi. to North Sea
commerce G-65, B-234, *map* G-66

Wesley, Charles (1707-88), English preacher and hymn writer (brother of John) W-72
secretary to Oglethorpe G-58

Wesley, John (1703-91), English preacher; founder of Methodism W-71-2
views on witchcraft W-128

Wesleyan College, at Macon, Ga.; Methodist Episcopal institution for women; founded 1836; arts and science, music: G-56

Wesleyan Methodists, the original Methodist body, founded by John Wesley in Great Britain. *See in Index* Methodism

Wesleyan University, at Middletown, Conn.; for men; non-sectarian; established 1831 by Methodist Episcopal church; arts and science: *picture* C-337

Wes'sex, ancient kingdom of West Saxons in s. Britain; founded by Cedric and Cynric 519; Egbert became king 802, and later ruled all Britain
in Thomas Hardy's novels H-220

West, Benjamin (1738-1820), American painter, born Springfield, Pa.; lived in London after 1763, enjoying both artistic and social success; historical painter to George III of England (1772-1811); encouraged and influenced many young American artists: P-26-7

West, James Edward (born 1876), a leader in Boy Scout work, born Washington, D. C.; secretary, President Theodore Roosevelt's White House Conference on care of dependent children; appointed chief Scout executive, 1911; became editor of *Boys' Life*, 1922.

West, John (1775?-1845), English missionary of Church of England, born Sussex, England; 1820-23 chaplain to Hudson's Bay Company in Red River Settlement.

West, Rebecca (born 1892), pen name of Cicily Fairfield (Mrs. Henry Maxwell Andrews), English critic, essayist, and novelist; wrote first magazine article at 17 and drew attention of literary world as clever, keen book reviewer ('The Return of the Soldier'; 'The Judge'; 'Harriet Hume', novels; 'The Strange Necessity', criticism).

West, The F-13-17. *See also in Index* Far West; Great Plains; Southwest, American; *also* names of states

West Allis, Wis., industrial suburb 4 mi. w. of Milwaukee; pop. 36,364; automobiles, trucks, engines, machinery.

West Baden, Ind., town about 85 mi. s.w. of Indianapolis; pop. 949; health resort, mineral springs: *map* I-46

Westborough, Mass., town 12 mi. e. of Worcester; straw and felt hats; weaving, tanning; pop. 6463; birthplace of Eli Whitney.

West Bromwich (*brŏm'ĭch*), England, manufacturing town 5 mi. n.w. of Birmingham; pop. 81,000; coal and iron mines, metal manufactures.

Westbrook, Me., city 6 mi. n.w. of Portland on Presumpscot River, in farming region; pop. 11,087; paper, cotton, silk.

West Chester, Pa., borough 20 mi. w. of Philadelphia; pop. 13,289; dairy implements, dustless crayons, gas engines, shipping tags; creameries, tree nurseries; state teachers college: *map* P-112

West coast hemlock. *See in Index* Western hemlock

Westerly, R. I., town on Pawcatuck River 37 mi. s.w. of Providence; pop. 11,199; printing presses, cotton and elastic webbing, cotton cloth, silk, rayon, granite.

Westerly winds W-112, *picture* W-113
rainfall R-47

Westermarck, Edward Alexander (1862-1939), Finnish anthropologist and author; professor sociology, University of London, 1907-30; especially interested in history of marriage and ethical origins ('The History of Human Marriage'; 'Origin and Development of the Moral Idea'; 'Essays on Sex and Marriage'; 'Memories of My Life')
quoted on marriage M-68

Western Australia, largest state of Australia, comprising w. third of continent; 975,920 sq. mi.; pop. 440,000, mainly on coast and in mining sections; gold, copper, silver mining, farming; cap. Perth: A-368, *map* A-372a

Western balsam poplar. *See in Index* Black cottonwood

Western bluebird B-159

Western College, at Oxford, Ohio; for women; non-sectarian; founded 1853; liberal arts.

Western cricket. *See in Index* Mormon cricket

Western crow C-403

Western Empire, in Roman history R-136, E-322

Western grebe G-151

Western Hemisphere. *See* Hemisphere

Western hemlock, an evergreen tree (*Tsuga heterophylla*) of the pine

ü=French *u*, German *ü*; ġem, ḡo; thin, *th*en; ṅ=French nasal (Jeaṅ); zh=French *j* (*z* in azure); χ=German guttural *ch*

ü=French *u*, German ü; ġem, ḡo; thin, then; ṅ=French nasal (Jeaṅ); zh=French *j* (z in azure); к=German guttural *ch*

Whitworth College, at Spokane, Wash.; founded 1890 by Presbyterian church; arts and sciences, graduate school.

Wholesale trade, sale of goods in large quantities
cooperatives C-355, 355*a*
credit percentage C-393

Whole-tone scale M-315

Whole wheat flour F-119
bread B-229; food value B-231–2

Whooping cough G-78
control, *pictograph* H-255

Whooping crane S-297, B-145*b*

Whortleberry, English name for blueberry B-159

Whymper, Edward (1840–1911), English wood engraver and explorer; noted as a mountain climber; first to scale the Matterhorn and other peaks in the Alps, and Chimborazo in the Andes; explored Greenland and the Great Divide region in Canada; wrote and illustrated 'Scrambles Among the Alps'; 'Travels Amongst the Great Andes of the Equator'; and other books
climbs Matterhorn, *picture* A-136

Wich hazel, witch hazel, or hamamelis W-128

Wichita (*wich'i-tą*), tribe of plains Indians of Caddoan stock originally living on Arkansas River, Kansas, later in Wichita Mts. of Oklahoma; their tribal range in Kansas was the "Province of Quivara" of Coronado in 1851: I-54
dwellings I-59

Wichita, Kan., industrial city and wholesale trade center on Arkansas River 47 mi. n. of Oklahoma border; pop. 114,966: W-97, *map* K-4
airport, *picture* K-4

Wichita, Municipal University of, a municipal institution at Wichita, Kan.; created 1926 by expansion of Fairmount College (chartered 1895); colleges of liberal arts and sciences, business administration and industry, education, and fine arts; graduate school and schools of aeronautics and journalism.

Wichita Falls, Tex., rapidly growing city 100 mi. n.w. of Fort Worth; pop. 45,112; near extensive oil fields; large oil refineries; motor trucks, glass products, cottonseed oil, brick and tile; railroad shops; truck and fruit farming: *map* T-56

Wickard, Claude R. (born 1893), public official and agriculturist, born Carroll County, Ind.; entered office of Agricultural Adjustment Administration in 1933; made secretary of agriculture in President F. D. Roosevelt's cabinet, 1940, and U. S. food administrator December 1942–March 1943.

"Wicked Bible" B-105

Wicker furniture F-222

Wickersham, George Woodward (1858–1936), lawyer, born Pittsburgh, Pa.; attorney general under Taft; member of League of Nations committee for codifying international law; chairman of Hoover's commission on law enforcement.

Wicket, in cricket C-395

Wickham, Sir Henry Alexander (1846–1928), English explorer and pioneer planter in tropics R-164

Wiclif. See *in Index* Wyclif

Widdemer, Margaret (Mrs. Robert Haven Schauffler), American poet and novelist, born Doylestown, Pa.; treats commonplace with sympathy and understanding ('Factories', child-labor poem; 'The Old Road to Paradise', volume of poems; 'Gallant Lady', 'Rhinestones', and other novels; 'Winona Series' of girls' books).

Widener Memorial Library. *See in Index* Harvard University Library

Widgeon (*wij'ŏn*), the name of two river ducks: the American widgeon or baldpate found in most regions of North America is 18 to 21 in. long, the males brownish gray above and brownish red and white below with a white head crest; the European widgeon, which occurs in the n. part of the Eastern Hemisphere and occasionally in the Western, has the head and neck cinnamon-red.

Widor (*vē-dôr'*), **Charles-Marie** (1847–1937), French organist, composer, and writer on music.

"Widower," game P-252

"Widow's mite," in Bible. *See in Index* Lepton

Widsith (*vĭd'sĭth*), an Anglo-Saxon poem, part of which is said to be oldest English poem (probably written 4th century A.D.); Widsith, the "far wanderer," tells of kings he has visited.

Widukind (*wid'ų-kind*). *See in Index* Wittekind

Wieck (*vēk*), **Clara.** *See in Index* Schumann, Clara

Wied-Neuwied, Maximilian Alexander Philipp, Prince of. *See in Index* Maximilian, Alexander Philipp, prince

Wieland (*vē'länt*), **Christoph Martin** (1733–1813), German epic poet ('The Golden Mirror'; 'Agathon'; 'Oberon'): G-62

Wieliczka (*vē-yĕl-ēch'kä*), Polish town 9 mi. s.e. of Cracow; pop. 7000; famous salt mines.

Wien (*vēn*), **Wilhelm** (1864–1928), German physicist; the two laws named for him are concerned with the relations between wave-length as a measure of energy, and temperature; Nobel prize winner 1911; lectured at Columbia University 1913.

Wien (*vēn*), Germany. *See in Index* Vienna

Wieniawski (*vē-yĕn-yäf'skē*), **Henri** (1835–80), Polish violinist and composer; taught at St. Petersburg (Leningrad) and Brussels; toured U. S. with Rubinstein ('Legende'; 'Romance').

Wieniawski, Joseph (1837–1912), Polish pianist and composer, brother of Henri, with whom he made concert tours.

Wiesbaden (*vēs-bä'dn*), **Prussia**, beautiful watering place near Frankfort-on-the-Main on s. slopes of Taunus range 3 mi. n. of the Rhine River; pop. about 165,000.

Wiese, Kurt (born 1887), German-American illustrator and author of children's books; born Minden, Germany; books have rich international background ('Chinese Ink Stick'; 'Liang and Lo'; 'Buddy the Bear'); illustrated 'Bambi' by Felix Salten, and 'Jungle Book', by Kipling
Mowgli stories, *picture* K-24*a*

Wife of Bath, in 'Canterbury Tales' C-160, 162

Wig'an, England, manufacturing town of Lancashire, 15 mi. s. of Preston; pop. 85,000; collieries, iron and cotton industries; Mining and Technical College.

Wiggin, Kate Douglas (Mrs. Riggs) (1859–1923), American novelist and playwright, born Philadelphia; trained in kindergarten teaching in California; organized first free kindergartens on Pacific coast; won wide success among youthful readers with 'The Birds' Christmas Carol', story published in 1888 ('Rebecca of Sunnybrook Farm'; the Penelope Series; 'Mother Carey's Chickens')
contributor to *St. Nicholas* L-163

Wiggins, Carleton (1848–1932), American artist, born Turners, N. Y.; most noted for landscapes and realistic paintings of cattle and sheep ('A Holstein Bull'; 'Morning on the Hills').

Wigglesworth, Michael (1631–1705), American Puritan pastor; wrote 'The Day of Doom', a dismal Calvinistic poem which was popular in early New England.

Wight (*wīt*), **Isle of**, island off s. coast of England in English Channel; 147 sq. mi.; pop. 90,000: W-97, *map* E-270*a*
double tide S-212

Wigman (*vēg'män*), **Mary**, modern dancer, born Hanover, Germany, one of founders of modern German dancing; founded Wigman School in Dresden; first American tour 1930.

Wigs, fashions in D-107–9

Wig'wag signaling S-143

Wigwam (*wig'wąm*), Indian dwelling I-59, *pictures* I-53, 60
adapted by American colonists, *picture* A-162

Wil'berforce, Samuel (1805–73), English clergyman; Bishop of Oxford 1845–69; prominent in House of Lords.

Wilberforce, William (1759–1833), English philanthropist, leader of movement to abolish slave trade S-161

Wilbur, Ray Lyman (born 1875), American educator, physician, and public official, born Boonesboro, Iowa; president Stanford University; secretary of interior under President Hoover.

Wilcox, Ella Wheeler (1855–1919), popular American writer of poetry, prose; born Johnstown Center, Wis. ('Poems of Passion').

Wild, Jonathan (1682?–1725), English criminal who received stolen goods from a band of thieves and returned it to owner for a fee or sold it abroad; hanged at Tyburn; subject of stories, including Fielding's 'History of the Life of the Late Mr. Jonathan Wild the Great'.

Wild aster A-338–9

Wild canary, eastern goldfinch F-35, *picture* F-35, *color plate* B-138
nest B-126

Wild carrot, or Queen Anne's lace, a wild flower C-87

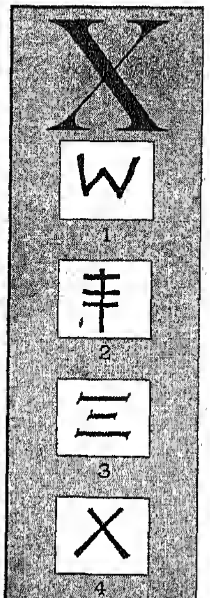
Wildcat, name in Europe of an undomesticated cat (*felix catus*); in America applied to the lynx, particularly *Lynx rufus*, or bobcat: L-223

Wildcat banks B-44

'Wild Duck, The', ironic play by Ibsen; the sincere but misguided reformer Werle in his eagerness to tell the complete truth brings disaster to the Ekdal family.

Wilde (*wīld*), **Oscar** (1856–1900), British author, born Dublin; as leader of the "esthetic movement" at Oxford, his affected manners and dress were imitated and his witty sayings widely quoted; after writing fairy tales and a novel, became famous for his brilliant plays ('Lady Windermere's Fan'; 'A Woman of No Importance'; 'The

ü=French *u*, German *ü*; ġem, ḡo; *th*in, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); ĸ=German guttural *ch*



OUR LETTER X really is a child of S. It was born when the Greeks learned how to write from the Phoenicians.

The new letter got its start because the Phoenicians had two signs, *shin* or *sin* (1), and *samekh* (2), for S, as told in the Fact-Index article on S. But the Greeks wanted only one sign for S, and eventually they chose the *sin* sign. This left the *samekh* sign available for other use, and several different uses for it grew up in Greece.

The eastern or Ionic Greeks used it for the sound which they called *xi* (pronounced 'ksee', with the first consonant sound run rapidly into the second). The sign itself came to be made without an upright stroke (3). The Chalcidian Greeks, who settled in southern Italy, used the same name and pronunciation; but they had come to use the sign for another letter (*chi*). This did not cause difficulty, however, because the Greek sign for T was extremely unlike the old Phoenician cross (4). The Chalcidian colonists therefore used the cross for *xi*.

When the Romans developed their Latin alphabet from the Greek, they took over the new letter and gave it the Chalcidian Greek sign; but they turned the Greek *name* around. Instead of ending the name with the sound of 'i', they placed this sound at the beginning. Thus the name became *iks*. From Latin the sign and the name came into English without change except for a shift from 'i' to 'e' at the start of the name. We call the letter *eks*.

The handwritten small 'x' is simply a capital, somewhat rounded for ease and speed in making; the printed small 'x' often preserves this rounding on one stroke.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

metallurgy aided by A-133
physics advanced by study P-195
plant growth influenced by P-245*f*
Pupin's contribution P-368*a*
radiation R-13–14, 15, X-200
spectrum S-244, X-200, A-362
tubes X-198–9, *picture* X-198: tungsten used T-150
welds tested by W-70

Xylem (*zī'lĕm*), woody fiber of trees, *diagram* T-131

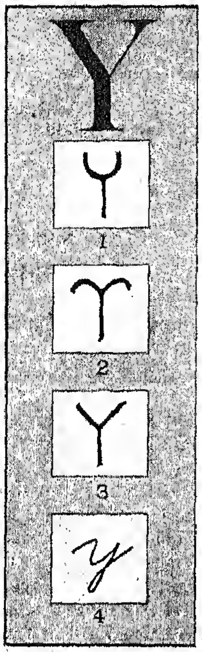
Xylography (*zī-lŏg'rȧ-fĭ*), method of block printing B-180

Xylol (*zī'lōl*), a coal-tar product C-288–9

Xylophone (*zī'lō-fōn*), musical instrument made of parallel wooden bars, graduated in length, which produce varied tones when struck with small mallets.

Xylose (*zī'lōs*), a sugar-like substance ($C_5H_{10}O_5$) S-322, C-376

'X Y Z' Affair, in U. S. history X-202, A-14



Our letter Y, like F, U, and W, is a child of the oldest alphabetic sign for V. This sign had the value of 'v' or 'w' in all the Semitic alphabets, as told in the Fact-Index article on the letter V.

When the Greeks learned to write from the Phoenicians, they learned the Semitic form of this letter (1). Among the Greeks, various groups used the sign for F, V, U, and W, and the Romans learned these uses when they formed the Latin alphabet, as told in the Fact-Index articles on these letters. For the sign itself, they used the V form which they had learned from the Chalcidian Greek colonists in southern Italy.

After the Romans had conquered the world, however, they learned that the most cultured of all the earlier Greeks, the Athenians, used a letter called *upsilon* for the vowel 'u' (2). Therefore, they commenced to use this sign in a simplified form (3) whenever it occurred in words translated from Athenian, or Attic, Greek. But they could not place it in the Latin alphabet after T, as the Athenians had done with *upsilon*, because in Latin the letter V held this place. The Romans therefore added the new Y after X, the letter which had ended their alphabet up to this time.

From Latin the letter came unchanged into English. But the pronunciation shifted gradually, in later Roman times and even more among the Anglo-Saxons, toward that of 'i', either long or short. Thus in time Y came to be an equivalent of I, as we see by comparing 'strike' with 'try', and 'sill' with 'symbol'. In modern English, the letter sometimes means a special sound, as in 'yacht', 'year'. The small handwritten 'y' (4) is a quickly made variant of the capital, linked with a continuous stroke to the adjoining letters.

Note.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Ya-Be-Chi dance, of the Navajos, *picture* F-135

Yablonoi (*yä-blō-noi'*) **Mountains**, a system of s. Siberia, extending from s.w. to n.e. 1000 mi. in the direction of the Stanovoi range; highest point about 8000 ft.

Yabu (*yä'bo̤*), Afghan horse A-29

Yachts and **yachting** B-164

Yad'kin River, N. C., rises in Blue Ridge Mts. and flows 300 mi. to South Carolina border; thence called Pee Dee: *map* N-156
Boone's home on B-192

Yaghan, or **Yahgan** (*yä'gän*), tribe of Indians in Tierra del Fuego C-207*c*, S-206

Yahoos (*yä'ho̤z*), in 'Gulliver's Travels' S-348

Yahweh (*yä'wĕ*). *See* Jehovah

Yak, a bovine animal of the Himalayas Y-203, *pictures* Y-203, A-326
altitude range, *picture* Z-228
carrying baggage, *picture* E-343
grinding grain, *picture* T-90

Yak'ima, Wash., industrial city and fruit and farming trade center in s. center; pop. 27,221; canned and dehydrated fruits, lumber, flour, iron and structural steel: *map* W-29

Yakima Indians, Shahaptian tribe formerly living in e. Washington along Columbia and Yakima rivers; originally were salmon fishers, hunters, and traders between tribes e. of Rockies and those w. of Cascades.

Yakima Valley, Wash., *picture* W-30
hop-picking, *picture* W-31

Yakutat (*yăk'ū-tăt*), Alaska, village on Yakutat Bay (*map* A-105), 150 mi. n.w. of Juneau; U. S. naval base.

Yakut (*yä-ko̤t'*) **Republic**, also **Yakutsk**, an autonomous republic of Russian Soviet Federative Socialist Republic, in e. Siberia; about 1,170,000 sq. mi.; pop. 400,000; gold, silver, lead, coal, furs; cap. Yakutsk (pop. about 10,000), on Lena River: S-138, *map* A-332*b*

Yakuts, a Turkic tribe of e. Siberia in vicinity of the Lena River.

Yale, Elihu (1648–1721), English philanthropist, born Boston, Mass.; founder of Yale College, now Yale University.

Yale lock L-176–7

Yale University, at New Haven, Conn.; for men, 3d oldest university in U. S.; non-sectarian; chartered 1701 as Collegiate School of Connecticut, name changed 1718 in honor of Elihu Yale; arts and science, graduate school, medicine, divinity, law, fine arts, music, forestry, nursing: *picture* C-340
boat races B-163
football coaches from F-151*b*–*c*, *d*
library L-106*j*
location in New Haven N-88

Yalu', a river 300 mi. long forming part of the boundary between Manchuria and Korea; it flows s.w. into the Bay of Korea; in the naval battle of the Yalu (1894), fought at its mouth, the Japanese destroyed the Chinese fleet; first important land battle of Russo-Japanese War (May 1904) fought on its banks: *map* M-49*a*

Yam, a vegetable resembling the sweet potato S-341

Yam, Chinese. *See* Cinnamon-vine

Yamagata (*yä-mä'gä-tä*), **Aritomo, Prince** (1838–1922), Japanese field-marshal; twice premier; leader of conservatives.

Yamamoto (*yä'mä'mō'tō*), **Isoroku** (1884–1943), commander in chief of the Japanese fleet, directed the Japanese attack on Pearl Harbor; killed in air combat April 1943.

Ya'masee, a former Muskhogean Indian tribe, originally of Georgia and Florida, later of South Carolina. Driven into Florida, they were exterminated.

Yamashita (*yä-mä'shĭ-tä*), **Tomoyuki** (born 1885), Japanese army officer, strategist, and military aviation expert; commander in chief of Japanese forces in Malaya; conquered Singapore, later Philippines.

Yanaon (*yȧ-nȧ-ôṅ'*), French India, seaport colony on e. coast of India at n. mouth of Godavari River; 7 sq. mi.; pop. 5000: I-43, *maps* I-31, A-332*c*

Yancey (*yăn'sĭ*), **William Lowndes** (1815–63), political leader, born Warren County, Ga.; strong states'-rights man and leader of radical secession from Democratic party which insured Lincoln's election.

Yang and Yin, in Chinese legend C-221*i*

Yangtze (*yäng-tsĕ'*) **River**, longest and most important waterway in China; rises in Tibet Y-203, C-211, A-330, *maps* C-211, A-332*a*, *b*–*c*
Hankow on H-210–11
valley life C-212–13

Yan'kee Y-204

"Yankee clippers" S-118, C-323, *picture* S-125

'Yankee Doodle' Y-204, N-24

Yankton, S.D., city on Missouri River 60 mi. n.w. of Sioux City in agricul-

ü=French *u*, German ü; ġem, ġo; *th*in, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); *K*=German guttural *ch*

geysers G-82–4, Y-205, *pictures* N-17, G-83
Mammoth Hot Springs Y-206, *picture* Y-205
obsidian G-28
Timberland Reserve F-157
wapiti herds W-7

Yellowstone River, tributary of Missouri; rises in n.w. Wyoming, flows n. and n.e. 800 mi. across Montana to North Dakota border; forms two great falls in Yellowstone National Park: *maps* M-243, U-188*b*
in Yellowstone Park Y-206

Yellow-throat, name given to several species of American warbler; best known is Maryland yellow-throat (*Geothlypis trichas*), found in most of United States and s. Canada; olive green above, yellow underneath; male has black forehead and cheeks: *picture* W-7

Yellow warbler W-7
nest B-126

Yellow water-lily, American lotus, water chinquapin, or **Nelumbo** L-199, W-48, *pictures* L-199, B-204

Yellow-wood, or **virgilia**, a genus of trees (*Cladrastis*) of the pulse family, with yellow wood (yielding a yellow dye), smooth bark, pinnate leaves and showy clusters of white flowers drooping from ends of the branches; bark used in medicine.

Yemen (*yĕm'ĕn*), Arabia, s.w. district on Red Sea; 75,000 sq. mi.; pop. about 3,000,000; mountainous country with low plains on coast; coffee, live stock; cap. Sana; Turkish vilayet before 1st World War: A-238, *maps* A-242, A-332*c*

Yen, the unit of the Japanese monetary system, nominally worth 50 cents, but variable in value; formerly coined in gold and silver, now coined only in gold in 5, 10, and 20 yen pieces; gold export forbidden since 1917.

Yen'bo, Saudi Arabia, coast city, seaport for Medina, *map* A-242

Yenisei (*yăn-yĕ-sā'ē*), one of great rivers of Siberia; rises in n.w. Mongolia, flows n. 3000 mi. to Bay of Yenisei, an inlet of Arctic Ocean; crossed by Trans-Siberian Railroad at Krasnoyarsk: A-330, S-188, *map* A-332*b*

Yeoman (*yō'măn*), term for common servant in early English history, later for small freeholder; British volunteer mounted troops of home defense called Yeomanry.

Yeoman, U. S. Navy, a petty officer charged with clerical duties
insignia, *picture* U-179

Yeomen of the Guard, also called **Beef-eaters**, members of the bodyguard of the king of England, first appointed by Henry VII in 1485; originally archers; warders of the Tower of London were named Yeomen Extraordinary of the Guard in reign of Edward VI and wear same uniform as Yeomen of the Guard: *picture* G-53
warders, uniform L-183–4

'Yeoman of the Guard', painting by Millais, *picture* M-174

Yerba Buena (*yĕr'bä bwā'nä*) **Island**, formerly called Goat Island, halfway between San Francisco and Oakland; 300-acre U. S. government reservation.

Yerba maté (*yĕr'bä mä-tā'*), or **Paraguay tea** T-22, 27, *picture* S-205*c*
Argentina A-280*a*, *pictures* A-280, A-281
Brazil B-226*d*

Yerkes (*yĕr'kēz*), **Charles Tyson** (1837–1905), American capitalist and munificent patron of science and art; obtained control of and exploited Chicago city railways by methods which were severely criticized; gave great Yerkes telescope to University of Chicago.

Yerkes, Robert M. (born 1876), American psychologist and biologist; born Breadysville, Pa.; professor of psychology and psychobiology, Yale, after 1924; author of many studies and books on anthropoid apes ('Almost Human', 1925; 'Mind of a Gorilla', 1927; 'The Great Apes', 1929): C-208

Yerkes Observatory O-194, *picture* O-193

Yermak (*yĕr-mäk'*) (died 1584), Cossack outlaw, chief of the Don Cossacks, and initiator of Russian conquest of Siberia; made prince of Siberia by Ivan the Terrible.

Yessenin (*yĕs-sān'yĭn*), **Sergei Aleksandrovich** (1895–1925), Russian poet
chief works, list R-198
place in Russian literature R-197

Yew, a shrubby conifer Y-206, *picture* P-273

Yew (*yṳ*) **family**, or **Taxaceae** (*tăks-ā'sē-ē*), a family of shrubs and trees, including the English yew, ground-hemlock, California-nutmeg, stinking-cedar, rimu, plum-yew, and the podocarpuses.

Yezd (*yĕzd*), Persia, city 165 mi. s.e. of Isfahan; pop. 30,000; on important trade route; cobalt, antimony, and nickel in vicinity: P-130, A-328, *map* A-332*b*

Yezidis (*yĕz'ē-dēz*), a people of Kurdistan, related to the Kurds; seek to propitiate devil, whom they represent as a peacock; they also worship Christ and Allah.

Yezierska, Anzia (born 1885), American writer, born Russia; came to U. S. 1901; stories of life among poor in East Side, New York City ('The Fat of the Land'; 'Hungry Hearts'; 'Salome of the Tenements'; 'Bread Givers'; 'Arrogant Beggar').

Ygdrasil (*ĭg'drä-sĭl*), in Norse mythology, tree of life O-202

Yid'dish, Jewish dialect H-267

Yin and Yang, in Chinese legend C-221*i*

Yingkow, also **Newchwang**, treaty port in s. Manchukuo at mouth of the Liao River; pop. 160,000: *maps* M-49*a*, J-186

Ylang-ylang (*ē'läng ē'läng*), a perfume P-124

Y.M.C.A., Young Men's Christian Association Y-208

Ymir (*ü'mĕr*), in Norse mythology, a frost giant, the first being created; slain by Odin and other gods, who formed earth from his body.

Yo, river in Africa, flows from east into Lake Chad.

Yoakum, Henderson (1810–56), American lawyer, historian of Texas; born Powell's Valley, Tenn.; active in politics and frontier warfare until 1845; moved to Huntsville, Tex. and fought in Mexican War; wrote 'History of Texas, 1685–1846', for 50 years the standard work.

Yoga, one of the systems of orthodox Hindu philosophy; seeks the union of the individual with the divine by means of a technique of exercise, breathing, posture, diet, and meditation.

Yoho National Park, a Canadian park in s.e. British Columbia, adjoining Banff and Kootenay national parks; noted for beautiful mountain scenery, waterfalls, and lakes: N-23, *map* C-50*b*

Yokohama (*yō-kō-hä'mä*), chief seaport of Japan, 17 mi. s. of Tokyo; pop. 970,000: Y-206–7, *map* A-332*b*
earthquake (1923) E-137
harbor, *picture* J-185

Yokuts, a linguistic stock of Indians, consisting of many small tribes, formerly living in s. central California.

Yolk, of egg E-258

Yolk, in wool W-145

Yom Kippur (*yŏm kĭp'ŭr*), or **Day of Atonement**, the most sacred holiday of the Jews, observed on the 10th day of Tishri (September or October) with prayer and fasting.

Yonge (*yŏng*), **Charlotte Mary** (1823–1901), English novelist and writer on religious and educational subjects ('The Dove in the Eagle's Nest'; 'Cameos of English History').

Yonkers, N. Y., manufacturing and residential city on Hudson River adjoining New York City on n.; pop. 142,598. Incorporated as village 1853, and chartered as city 1872. Philipsburgh Hall, original home (built 1682) of Philipse family who were prominent in early history of Yonkers, and Hudson River Museum contain valuable historical collections; Boyce Thompson Institute for Plant Research is finest of its kind in U. S.; St. Joseph's Seminary and College trains Catholic priests; Empire city track brings large crowds in racing season: *map* N-114
early history N-120
manufactures N-120

Yonne (*yŏn*), river in s. France tributary to Seine.

Yor'ick, in Shakespeare's 'Hamlet' former jester of King of Denmark; in Sterne's 'Tristram Shandy' the parson; name later used as pseudonym by Sterne.

York, Alvin C. (born 1887), American hero of 1st World War, born Fentress County, Tenn.; captured German machine gun battalion in Argonne Forest, 1918; established York Foundation to educate mountain children; newspaper columnist.

York, Richard, Duke of (1411–60), English prince; protector of England during illness of Henry VI; claimant for throne: R-156

York, England, industrial center, cap. of Yorkshire, near center on Ouse River; pop. 85,000; important Roman settlement; site of Cathedral of St. Peter (built 7th century, rebuilt 13th century), English Gothic with Saxon and Norman parts: *map* E-270*a*

York, Neb., city about 50 mi. w. of Lincoln in agricultural and stock-raising region; nurseries; pop. 5383; York College.

York, Pa., industrial and trade center in farming district 22 mi. s. of Harrisburg; pop. 56,712; dental supplies, bank safes and vaults, wall paper, glass, pottery, silk: *map* P-112

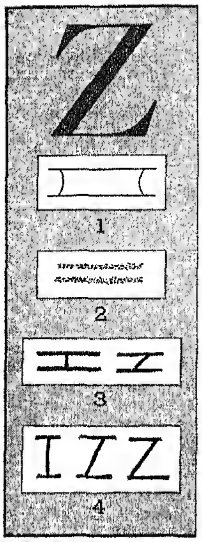
York, former name for Toronto T-113

York, House of, royal line in England, founded by Richard, duke of York, *table* R-158. *See also in Index* Roses, Wars of the
Edward IV, first of line E-190
list of rulers E-270

York Cycle, of mystery plays D-93

York River, in Virginia, flowing into Chesapeake Bay, *map* V-306

Yorkshire, largest county in England; in n.e. on North Sea; divided into



OUR LETTER Z probably started in Egypt as a sign which meant 'pool of water' (1). Soon after 2000 B.C., a Semitic people called the Seirites adopted it as an alphabetic sign for the sound of 'z'. Probably they did this because the horizontal lines of the Egyptian sign looked to them like two sticks. Since they called such sticks *zain* or *zayin*, the sign made a good symbol for the sound of 'z'.

The Seirites made the sign simply with two lines (2). The later Canaanite-Phoenician alphabet used a sign (3) more like the Egyptian picture. In Hebrew the sign was called *zayin;* other Semitic languages had similar names. In all Semitic alphabets, it stood in the seventh place, where the English alphabet places 'g'.

When the Greeks learned to write from the Semitic Phoenicians, they refined the sign (4) and called it *zeta* (pronounced *zayta*). The early Romans did not use the 'z' sound in their speech, and they gave a new sign the place of *zeta* in the alphabet, as told in the Fact-Index article on G.

After the Romans had conquered the Western World and become interested in Greek literature, they wanted to write the Greek 'z' in Latin. But its place in their alphabet had been given to G, and so they added it at the end. The English alphabet too, like the late Latin from which it came, ends with Z.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Zabrze (*zäb'zhĕ*), Germany. *See in Index* Hindenburg

Zacatecas (*sä-kä-tā'käs*), state in cent. Mexico; 28,122 sq. mi.; pop. 460,000; silver: *picture* M-135

Zacatecas, Mexico, capital of state of Zacatecas, 350 mi. n.w. of Mexico City; pop. 21,000; *map* M-133

Zacharias, or **Zachary, Saint**, pope (741–752) of Greek birth; took an active part in French and German affairs; commemorated March 13.

Zadkine (*zäd'kēn*), **Ossip** (born 1890), Polish painter and sculptor; lived chiefly in England and France; distinguished for work in abstract or geometric form.

Zadru'gas, community groups of related families, in Balkans S-81

Zaehnsdorf, Joseph W., English bookbinder, one of the foremost commercial binders of the 19th century; his rivals were Riviere & Son and Sangorski & Sutcliffe.

Zagreb (*zäg'rĕb*), or **Agram** (*ä'gräm*), Yugoslavia, city 80 mi. n.e. of Fiume; formerly cap. of Croatia-Slavonia; pop. 185,000; linen, carpets, leather; university: *map* E-326*d*

Zaharoff, Sir Basil Zachariah (1849–1936), international financier, born Phanaz, Turkey; his mother was a Greek, his father a Russian; as financial backer of European munition makers, was influential in international affairs during Balkan wars and 1st World War; said to have been wealthiest man in Europe.

Zaimis (*zä'ē-mēs*), **Alexander** (1855–1936), Greek statesman, six times premier; president 1929–35.

Zaluski (*zä-lṳs'kĭ*) **family**, an influential family of Poland; Andrew Chrysostom (1650–1711), bishop and orator; Joseph Andrew (1702–74), bishop, collector of books and manuscripts: L-106

Zaluzianskya (*zăl-ū-zĭ-ăn'skĭ-ȧ*), a genus of annual and perennial plants of the figwort family, native to South Africa. One species grows to one ft.; flowers, in flat clusters, are deeply cut like snow crystals, white or lilac inside, with orange eye at center, purple outside; stems hairy; sometimes called lace verbena or night-phlox; fragrant in evening.

Za'ma, battle of (202 B.C.) H-211

Zambezi (*zăm-bē'zĭ*) **River**, 4th largest river of Africa Z-215, *map* S-202
Victoria Falls V-296

Zamboanga (*thäm-bō-än'gä*), Philippine Islands, largest city on island of Mindanao, and capital of province of Zamboanga; important port and market for timber, abaca, copra, hemp; settled by Spanish, 1635; pop. 130,000; *map* P-10*b*

Zamenhof (*zä'mĕn-hŏf*), **Lazarus Ludwig** (1859–1917), Russian philologist, inventor of Esperanto E-303

Zamora, Niceto Alcalá. *See in Index* Alcalá Zamora

Zancle (*zăn'klē*), ancient name of Messina S-140

Zandeh. *See in Index* Niam-Niam

Zandonai (*dzän-dō-nä'ē*), **Riccardo** (born 1883), Italian composer, chiefly of operas ('Francesca da Rimini', based on tragedy by D'Annunzio).

Zane, Ebenezer (1747–1811), American pioneer; made first lasting settlement on Ohio River (now Wheeling, W. Va.), and helped found Zanesville, O.

Zanesville (*zānz'vĭl*), Ohio, city 52 mi. e. of Columbus at junction of Muskingum and Licking rivers; pop. 37,500; famous for pottery and chinaware: *map* O-210
pottery O-212

Zang'will, Israel (1864–1926), British (Jewish) novelist and dramatist, leader in Zionist movement ('Children of the Ghetto'; 'The Melting Pot').

Zan'te Island, one of Ionian Islands; wine, olives, citrus fruits, mineral pitch: *map* B-18

Zanzibar, capital of Zanzibar Protectorate; pop. 45,000: Z-215–16, *map* E-139, *pictures* Z-215, A-41

Zan'zibar, island of Zanzibar Protectorate off e. coast of Africa; 640 sq. mi.; pop., with island of Pemba, 245,000: Z-215–16, *map* E-139

Zanzibar Protectorate (Zanzibar and Pemba), under Great Britain; over 1000 sq. mi.; pop. 245,000: Z-216, *map* E-139

Zapa'ta, Emiliano (died 1919), Mexican revolutionist M-142*e*, *b*

Zaporozhe (*zä-pō-rô'zhĕ*), or **Zaporozhie**, formerly **Alexandrovsk**, city in Russia in Ukraine, on Dnieper River; pop. 290,000; industrial center: K-15, *map* E-326*e*

Zapotecs (*sä-pō-tĕks'*), Indian tribe of s. Mexico, which at time of Spanish conquest formed a powerful nation occupying part of present state of Oaxaca: M-142*d*
Mitla, *picture* M-142*c*

Zapouna, ancient Phoenician city with enlightened culture; remains of a large library have been found, including a "dictionary" inscribed on clay tablets.

Zara (*zä'rä*), Italy, Adriatic port on Dalmatian coast, 90 mi. s.e. of Fiume; pop. 19,000; assigned to Italy by Treaty of Rapallo (1920): *maps* B-18, I-156

Zarago'za, Spain. *See* Saragossa

Zarathus'tra. *See* Zoroaster

Zauditu (1876–1930), empress of Ethiopia after 1916; daughter of Menelik II; shared rule with Ras Tafari, who became Emperor Haile Selassie after her death.

Ze'a, genus of American grasses, including corn.

Zealand (*zē'lănd*), Danish **Sjaelland** (*shĕl'län*), largest of the Danish islands; 2709 sq. mi.; pop. 1,340,000: D-52, *map* D-53
Copenhagen harbor C-356

Ze'bra Z-216, *color plate* A-36*c*

Zebra fish A-234

Zebra wolf, Tasmanian wolf, or thylacine T-15

Ze'bu, the Indian ox Z-216, C-102
cross breeding C-105

Zebulon (*zĕb'yṳ-lŏn*), Hebrew patriarch, son of Jacob and ancestor of the tribe of Zebulon.

Zechariah (*zĕk-ȧ-rī'ȧ*) (6th–5th cen-

ü=French *u*, German *ü*; ġem, ḡo; *th*in, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); ĸ=German guttural *ch*

ü=French *u*, German *ü*; ġem, ḡo; thin, *th*en; ṅ=French nasal (Jeaṅ); zh=French *j* (z in azure); κ=German guttural *ch*